PROGRAM REVIEW
1987-88
NORTHERN FORESTRY CENTRE

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PROGRAM REVIEW 1987-88

NORTHERN FORESTRY CENTRE
CANADIAN FORESTRY SERVICE
1988

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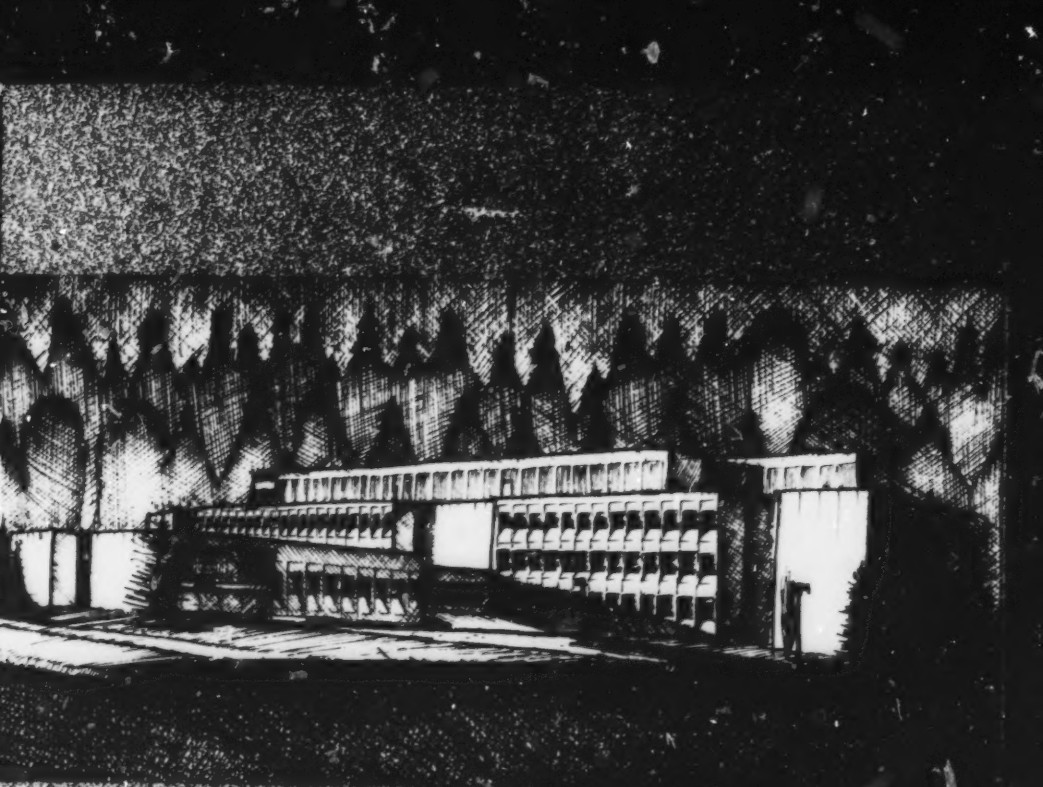


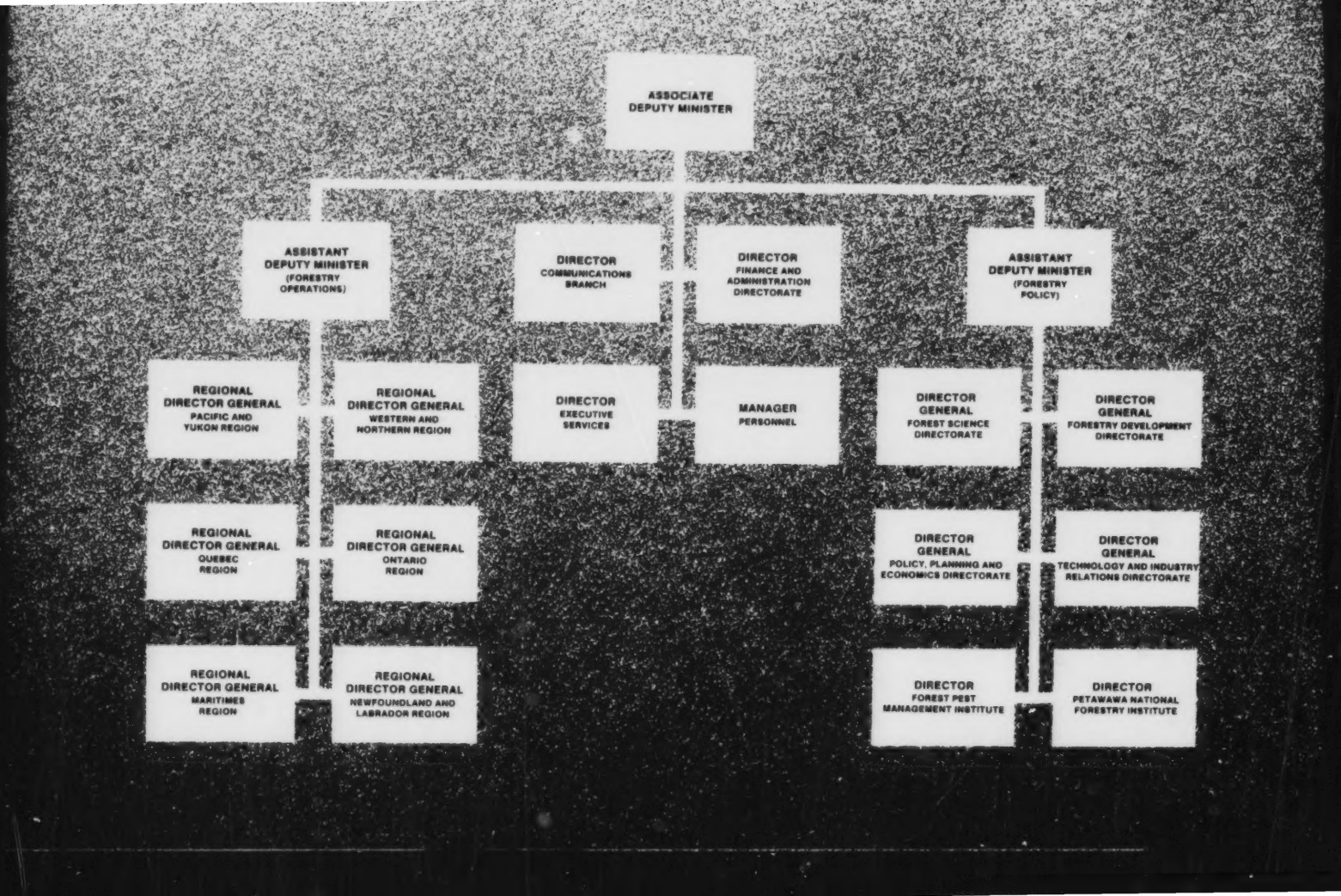
The Canadian Forestry Service is the main focus for forestry matters in the federal government. It provides national leadership through the development, coordination, and implementation of federal policies and programs to enhance long-term economic, social, and environmental benefits to Canadians from the forest sector.

The service is a decentralized organization with six regional forestry centres, two national research institutes, and seven regional sub-offices located across Canada. Headquarters is located in the national capital region, in Hull, Quebec.

In support of its mandate, the Canadian Forestry Service carries out the following activities:

- Administers forest development agreements negotiated with the provinces;
- Undertakes and supports research, development, and technology transfer in forest management and utilization;
- Compiles, analyzes, and disseminates information about national and international forest resources and related matters;
- Monitors disease and insect pests in Canada's forests;
- Provides information, analyses, and policy advice on economics, industry, markets, and trade related to the forest sector;
- Promotes employment, education, and training opportunities in the forest sector;
- Promotes public awareness of all aspects of the forest sector.

The service interacts regularly with provincial and territorial governments, industry, labor, universities, conservationists, and the public through such bodies as the Canadian Council of Forest Ministers, the Forest Sector Advisory Council, the Forestry Research Advisory Council of Canada, the Canadian Forest Inventory Committee, the Canadian Committee on Forest Fire Management, the Canadian Interagency Forest Fire Centre, and regional consultative committees. The service is also active in international forestry agencies such as the International Union of Forest Research Organizations and the Food and Agriculture Organization, as well as in technical and trade missions.


ASSOCIATE DEPUTY MINISTER
ASSISTANT DEPUTY MINISTER (FORESTRY OPERATIONS)
DIRECTOR COMMUNICATIONS BRANCH
DIRECTOR FINANCE AND ADMINISTRATION DIRECTORATE
ASSISTANT DEPUTY MINISTER (FORESTRY POLICY)
REGIONAL DIRECTOR GENERAL PACIFIC AND YUKON REGION
REGIONAL DIRECTOR GENERAL WESTERN AND NORTHERN REGION
DIRECTOR EXECUTIVE SERVICES
MANAGER PERSONNEL
DIRECTOR GENERAL FOREST SCIENCE DIRECTORATE
DIRECTOR GENERAL FORESTRY DEVELOPMENT DIRECTORATE
REGIONAL DIRECTOR GENERAL QUEBEC REGION
REGIONAL DIRECTOR GENERAL ONTARIO REGION
DIRECTOR GENERAL POLICY, PLANNING AND ECONOMICS DIRECTORATE
DIRECTOR GENERAL TECHNOLOGY AND INDUSTRY RELATIONS DIRECTORATE
REGIONAL DIRECTOR GENERAL MARITIMES REGION
REGIONAL DIRECTOR GENERAL NEWFOUNDLAND AND LABRADOR REGION
DIRECTOR FOREST PEST MANAGEMENT INSTITUTE
DIRECTOR PETAWAWA NATIONAL FORESTRY INSTITUTE

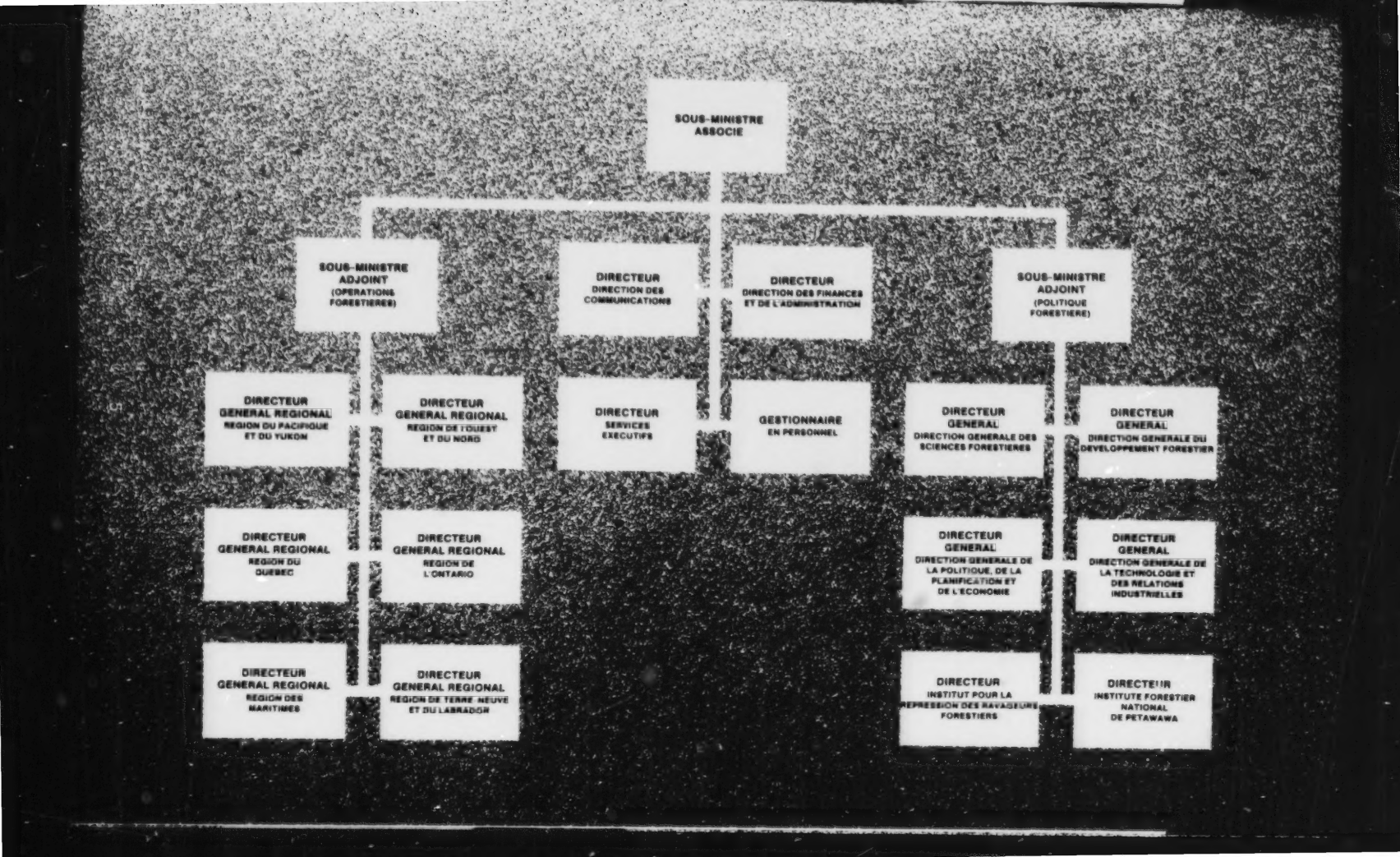
Le Service canadien des forêts est l'organisme principal en matière de foresterie à l'intérieur du gouvernement fédéral. Chef de file sur le plan national, il assure la préparation, la coordination et la mise en oeuvre des politiques et programmes fédéraux dans le but d'améliorer les avantages économiques, sociaux et environnementaux à long terme offerts aux Canadiens par le secteur forestier.

Le Service est une organisation décentralisée: six centres de foresterie régionaux, deux instituts de recherche nationaux ainsi que sept sous-bureaux régionaux sont répartis dans tout le Canada. Le siège social est établi dans la région de la Capitale nationale, à Hull (Québec).

Pour remplir son mandat, le Service canadien des forêts assume les tâches suivantes:

- il administre les accords de développement forestier conclus avec les provinces;
- il entreprend et appuie la recherche, la mise au point et le transfert technologique dans le domaine de la gestion et de l'utilisation des forêts;
- il rassemble, analyse et diffuse de l'information sur les ressources forestières nationales et internationales et les domaines connexes;
- il fait des relevés des maladies et des insectes ravageurs des forêts canadiennes;
- il fournit de l'information, des analyses et des conseils (quant aux politiques) concernant l'économie, l'industrie, les marchés et le commerce reliés au secteur forestier;
- il favorise les occasions d'emploi et de formation universitaire et technique dans le secteur forestier;
- il encourage les Canadiens à prendre conscience de tous les aspects du secteur forestier.

Le Service entretient des rapports sur une base régulière avec les gouvernements provinciaux et territoriaux, l'industrie, le monde du travail, les universités, les environnementalistes et le public par l'entremise d'organismes comme le Conseil canadien des ministres des Forêts, le Conseil consultatif du secteur forestier, le Conseil consultatif de la recherche forestière du Canada, le Comité de l'inventaire des forêts du Canada, le Comité canadien de la gestion des incendies de forêt, le Centre interservices des feux de forêt du Canada et des comités consultatifs régionaux. Le Service joue également un rôle actif dans des organismes internationaux de foresterie comme l'Union internationale des organisations de recherche forestière et l'Organisation pour l'alimentation et l'agriculture, de même qu'au sein de délégations de nature technique ou commerciale.


SOUS-MINISTRE ASSOCIE
SOUS-MINISTRE ADJOINT (OPERATIONS FORESTIERES)
DIRECTEUR DIRECTION DES COMMUNICATIONS
DIRECTEUR DIRECTION DES FINANCES ET DE L'ADMINISTRATION
SOUS-MINISTRE ADJOINT (POLITIQUE FORESTIERE)
DIRECTEUR GENERAL REGIONAL REGION DU PACIFIQUE ET DU YUKON
DIRECTEUR GENERAL REGIONAL REGION DE L'OUEST ET DU NORD
DIRECTEUR SERVICES EXECUTIFS
GESTIONNAIRE EN PERSONNEL
DIRECTEUR GENERAL DIRECTION GENERALE DES SCIENCES FORESTIERES
DIRECTEUR GENERAL DIRECTION GENERALE DU DEVELOPPEMENT FORESTIER
DIRECTEUR GENERAL REGIONAL REGION DU QUEBEC
DIRECTEUR GENERAL REGIONAL REGION DE L'ONTARIO
DIRECTEUR GENERAL DIRECTION GENERALE DE LA POLITIQUE, DE LA PLANIFICATION ET DE L'ECONOMIE
DIRECTEUR GENERAL DIRECTION GENERALE DE LA TECHNOLOGIE ET DES RELATIONS INDUSTRIELLES
DIRECTEUR GENERAL REGIONAL REGION DES MARITIMES
DIRECTEUR GENERAL REGIONAL REGION DE TERRE-NEUVE ET DU LABRADOR
DIRECTEUR INSTITUT POUR LA REPRESSION DES RAVAGEURS FORESTIERS
DIRECTEUR INSTITUTE FORESTIER NATIONAL DE PETAWAWA

DIRECTOR'S REPORT

During the review year, the Northern Forestry Centre (NoFC) made significant progress on a number of fronts. Notable accomplishments were made in the areas of research and regional development, both nationally and regionally.

Following several years of consultation, the Canadian Council of Forest Ministers (CCFM) released *A national forest sector strategy for Canada* to guide the development and implementation of forest sector policies and programs. In February 1988, the CCFM sponsored a forum on *Innovation and Technology: Science in the Forestry Sector* in Edmonton to recommend new directions in support of a greater and more focused research and innovation effort by all concerned. Coincident with these major events, the Canadian Forestry Service published *Focus on research: an outline of the CFS strategic plan for research* as a basis for programs "to enhance the economic, social and environmental benefits derived from forests and forest-based industries in Canada ..." to 1992. These documents reflect an impressive level of concensus about forest sector policies and program directions to meet the challenges of the future!

In response to a recommendation by the CCFM, NoFC initiated, in cooperation with the provinces, a review of the existing research advisory structures in the prairie provinces and the Northwest Territories to develop user-oriented, provincial-level advisory committees, acceptable to each jurisdiction. It is expected that the review will be completed in 1988–89. In the meantime, NoFC management continues to implement recommendations of the Senior Regional Advisory Committee (SRAC) as a key element of strategic and operational planning.

In the area of research, the highlight of the year was the publication of *Tree and shrub insects of the prairie provinces* by W.G.H. Ives and H.R. Wong (Information Report NOR-X-292). This special report contains 1100 color photographs, and its publication was made possible with funding support of the federal-provincial forest resource development agreements in Alberta, Saskatchewan, and Manitoba. Northern Forestry Centre scientists completed a major study of ecological changes in forest systems caused by sour gas plants near Rocky Mountain House in Alberta. Good progress was made in the vegetation management study aimed at a better understanding of possible silvicultural and environmental concerns related to chemical and manual treatments of forest systems in west-central Alberta.

The attainment of our forest site classification objectives was facilitated by several application-oriented workshops based on our *Field guide to forest ecosystems of west-central Alberta*. A users manual was prepared for the FORCYTE growth simulation model, and work was initiated to apply the model to boreal aspen and mixedwood management. A highly successful symposium on the management and utilization of northern mixedwoods focused attention on the issues and opportunities associated with this important forest type. A new series, Technology Transfer Notes, was launched to enable individual researchers to quickly communicate findings and information to client agencies.

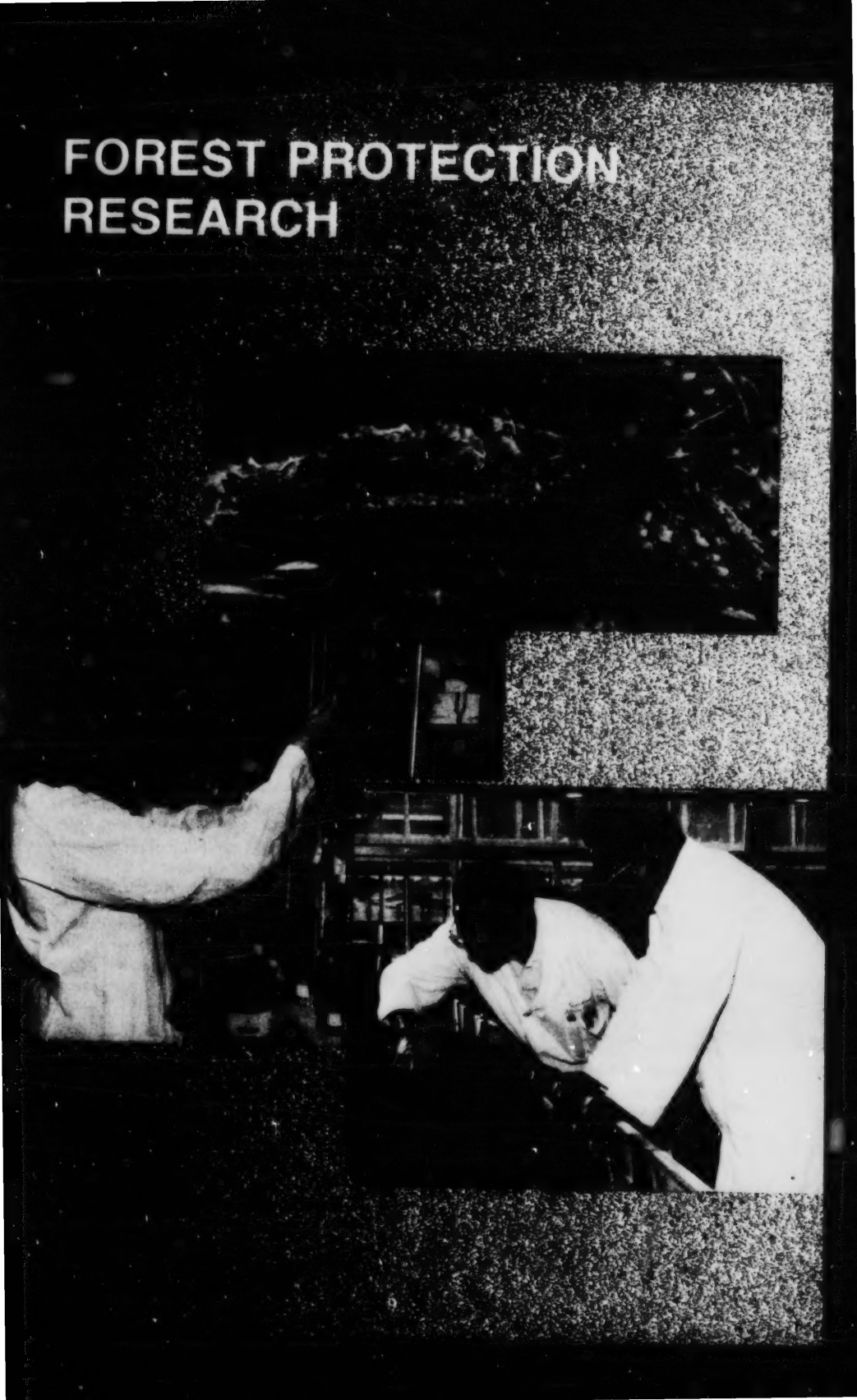
We passed the half-way point in the life of the three federal-provincial forest resource development agreements and continued to make excellent progress in program delivery. Numerous projects were completed under the Canada-Alberta Forest Resource Development Agreement, including the development of a permanent sample plot catalogue and the successful marketing and sales performance of Westlam laminated beams using Alberta spruce and pine. In Saskatchewan, a federally delivered private woodlot extension program continued to expand and reached 30 woodlots by the end of 1987–88. The Canada-Manitoba Forest Renewal Agreement provided funding support for the establishment of four tree seed orchards in the province, thereby capitalizing on the availability of superior seed from a jack pine tree improvement program initiated in the mid-sixties.

The Northern Forestry Centre and its offices in Manitoba and Saskatchewan continued to participate in a major exhibition circuit to inform over 100 000 visitors about the importance of forests and the forest industry to their economic and social well being.

During the year, NoFC staff were recognized for a number of accomplishments. Steve Zoltai shared with two other scientists a Group Achievement Merit Award from the Government of Canada for their work on wetlands ecology and conservation. Dr. Yasu Hiratsuka received the Dr. and Mrs. D.L. Bailey Award from the Canadian Phytopathological Society for *Forest tree diseases of the prairie provinces*, an Information Report published in 1987. Congratulations to these two and other staff members who contributed so much to our mission in 1987–88.

A.D. Kiil
Regional Director General

FOREST PROTECTION RESEARCH



OBJECTIVE

To determine the impact of pollutants on native soils and forest ecology; to provide federal, provincial, and industrial resource managers with advice on the assessment of air pollution impact on forest soils and vegetation; to determine the fate of herbicides and herbicide residues used in forestry applications in native soils and the impact of herbicides on native plant communities and key species; to determine the influence of herbicide application and other silvicultural practices on the long-term stability of nutrient balance and the biological and chemical control of tree nutrient requirements and uptake; to assess the impacts of industrial development on the terrestrial environment and recommend measures for mitigating the damaging impacts of the proposed developments; to provide analytical services to Northern Forestry Centre staff as required by ongoing research studies and develop new analytical techniques as required.

ACHIEVEMENT

Advisory services have been provided to the Regional Mining Committee offering terrestrial environment expertise (northern development), to ARNEWS (Acid Rain National Early Warning System), and to the Northern Forestry Centre Environmental Screening Committee. The study of ecological changes in forest systems caused by sour gas plants near Rocky Mountain House has been completed. One important outcome of this research was related to the large variability associated with biological measurements. The results have indicated that the capability to predict subtle pollutant impact using conventional plant and soil measurements is very limited because of the tremendous variability in the forest ecosystems, especially in situations where the pollutant effects are soil mediated. This emphasizes the need to adequately assess the natural variability associated with ecological measurements.

Some of the information on the variability associated with field measurements of biological systems is being utilized in the forest vegetation management study. Samples for the analysis of vegetation and soil nutrients were taken before and after the herbicide treatment to determine the impact of hexazinone on native plant communities and soil nutrient balance. A smaller-scale, more-controlled field experiment was set up in 1987 to study the processes involved in possible direct or indirect effects of Pronone on the interrelationship between vegetation and soil nutrients. Material was also collected and a growth chamber study designed for a study of the effects of Pronone on decomposition and nitrogen, phosphorus, and sulfur transformations under optimum conditions.

The vegetation management study is still in its initial stages, and most of the work to date has been in the set-up of the plots and in the collection of samples. Collation and interpretation of the vegetation analyses have begun, and analyses of the soil and plant material also were started. Preliminary studies on the distribution of Pronone applications by ground and helicopter were completed. In addition, detailed greenhouse studies on the effects of various herbicides (including hexazinone) on mycorrhizal associates have been completed, and two journal articles were published. These experiments, along with the field and laboratory studies in progress, will lead to a better understanding of the possible environmental concerns related to the application of Pronone in a forest system.

The analytical laboratory performed approximately 26 000 analyses on 5000 samples. It is one of two Canadian laboratories involved in an international check sample

program. The laboratory has also continued involvement in similar provincial and national quality assurance programs. In support of the nutrient cycling study, a method for extractable sulfur determinations in surface organic forest horizons was developed and has been published. Tests on the use of a microwave digestion system that will eliminate the use of perchloric acid (a safety concern) for plant and organic soil digestions have been completed.

STUDIES

Assessment of air pollutant impact on forest systems and of industrial development in natural areas

Analytical services laboratory

Nutrient cycling and dynamics in relation to silvicultural practices and environmental pollutants

Environmental impact and residue chemistry of forestry herbicides

TASKS

To prepare journal articles on the influence of pollutant deposition on uptake by plant communities including lichens, on soil chemistry and biology, and on vascular plant physiology; to continue to measure the rate and effect of pollutant deposition on soil chemistry and tree response; to reexamine biomonitoring plots around sour gas plants; to sample the plots in the bench-mark study on the impact of vegetation management methods, including herbicides; to operate and maintain a herbicide residue analytical laboratory; to publish results of experiments on the effects of hexazinone and Roundup on in-vitro growth of mycorrhyzae; to study the fate of herbicides and herbicide residues in forest soils and vegetation and the influence of herbicide application and other silvicultural practices on the long-term stability of nutrient balance and the biological and chemical control of tree nutrient requirements and uptake; to provide analytical services to the Northern Forestry Centre as required by ongoing research studies.

PROJECT STAFF

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(*From Aug. 1987*)
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(*Resigned July 1987*)
F.G. Radford
J. Shuya

FOREST [illegible] SURVEYS AND SYSTEMS

OBJECTIVES

To gather new knowledge of major forest insects, diseases, and other damage agents including acid rain for the purpose of understanding and minimizing damage attributable to these agents; to contribute to a national overview of important forest pests and to the ARNEWS (Acid Rain National Early Warning System) program; to conduct research on the biology and damage impact of specific insects and diseases; to develop or modify appraisal methods for assessment of losses caused by forest pests; to maintain and upgrade reference collections of insect and disease specimens; to conduct quarantine-related surveys.

ACHIEVEMENTS

Infestations of important pests were monitored, mapped, and assessed for damage impact, and the results were summarized for regional and national publications. Areas of defoliation were caused by the spruce budworm, forest tent caterpillar, and jack pine budworm; tree mortality was contributed by mountain pine beetle, spruce beetle, and Armillaria root rot; and various tree growth defects resulted from dwarf mistletoe, pine stem rusts, and several insect pests. Several special surveys were completed, including a region-wide spruce budworm pheromone trial, a pinewood nematode survey, and surveys for nursery pests.

Pest extension services were provided by processing about 2000 inquiries and by setting up information booths on several occasions. Information on tree pests was disseminated to various agencies and the public via pest leaflets, publications, slide presentations, lectures, and workshops. Several special surveys and collections were made for new or introduced pests in natural stands, nurseries, and plantations. The ARNEWS plots were monitored for insect and disease damage, increment cores were measured, and all basic plot data were sent to the Petawawa National Forestry Institute. Functional guidance was provided to insect and disease survey staff in Manitoba under the Canada-Manitoba Forest Renewal Agreement, and insect and disease projects were continued under the Canada-Alberta and Canada-Saskatchewan forest resource development agreements.

Field studies were continued in cooperation with the University of Calgary, Alberta Forest Service, B.C. Ministry of Forests, and Crestbrook Forest Industries toward the development and application of pheromones (behavior-modifying chemicals) for detection, monitoring, and control of the spruce beetle.

Surveys and damage impact studies of jack pine budworm infestations in Saskatchewan and Manitoba were continued for ongoing estimation of losses. Jack pine budworm pheromone baits were field tested as a potential tool for population census in a cooperative study with the Research Productivity Council in New Brunswick.

Assessments of regional pest depletion losses were begun using the new FIDS (Forest Insect and Disease Survey) geographic information system, in which survey maps are being collated, coded, and digitized. The newly created Regional Insect and Disease Technical Advisory Committee held its first two meetings in 1987 with representation from the Northern Forestry Centre, provincial and territorial governments, Parks Canada, universities, and the forest industry.

Collaborative studies were continued on Armillaria root rot, microorganisms and

blue stain fungi associated with the mountain pine beetle, western gall rust, and storage mold and damping-off disease in conifer seedlings.

[redacted]

Forest insect and disease surveys

Sawfly systematics

Biological assessment of insects injurious to trees and forests

Forest insect diagnostic and biosystematic services

Damage appraisal of major forest pests

Forest tree rusts of western North America

Forest diseases: research and technical transfer services

Effects of ice-nucleating agents on canker, dieback, and mortality of juvenile forest trees and amenity species

[redacted]

To survey, map, and report on major pest infestations such as the mountain pine beetle, spruce beetle, forest tent caterpillar, and spruce and jack pine budworms; to monitor other noteworthy forest pests; to provide diagnostic and advisory services; to modify and develop appraisal methods for assessment of losses caused by major forest pests; to conduct research on selected economically important forest tree insect and disease species, including western gall rust, terminal weevils, Armillaria root rot, aspen decays, jack pine budworm, and pests of seeds and cones, nurseries, and plantations; to contribute to the Acid Rain National Early Warning System regarding damage to the forest; to maintain and upgrade the forest insect and disease reference collections and data base; to identify and test field response of adult insect species to pheromones; to design forest pest management systems for major insect and disease pests.

[redacted]

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WETLANDS AND PEATLANDS

OBJECTIVES

To determine the ecology of peatland development within the region; to develop guidelines for peatland management and rehabilitation; to improve the yields of forests through the drainage of waterlogged forest soils; to evaluate the effects of drainage on the hydrology of drained and undrained wetlands; to determine the extent and degree of past short- and long-term climate fluctuations and the interrelationship between key parameters and measures of forest biomass productivity in selected regions of the boreal forest; to synthesize the available biomass data for the regionally important tree species for predicting biomass; to determine the risk of forest losses through fires, insects, and diseases in the boreal forest; to investigate the impact of biomass removal on site quality, nutrient status, silvicultural options, and long-term site productivity on selected sites in the prairie provinces.

ACHIEVEMENTS

Project staff participated in the planning and execution of an international meeting, Symposium '87—Wetlands/Peatlands, held in Edmonton. Papers on nutrient-vegetation relationships in peatlands and improving tree growth through peatland drainage in Alberta were presented by project staff. An Information Report, *Improving wetlands for forestry in Canada*, was published. Ditching was completed in all three experimental areas in Alberta for the wetland drainage and improvement project. Peat, water, and foliage samples are being collected from permanent sample plots to assess site fertility and determine the effect of drainage on stream water quality. Work was initiated on risk factor modeling by collecting existing Alberta data and testing them for stochastic determination of fire rates. Various models were tested for computing fire occurrence probabilities. The probabilities of expected timber volumes under different rotations and fire risk levels were determined for a test area.

Under the ENFOR (ENergy from the FORest) program, an Information Report entitled *Estimating downed-dead roundwood fuel volumes in central Alberta* was published. Other ENFOR projects concerned development of regression equations for small-diameter trees, a survey of forest resources south of Weyerhaeuser's limits in Saskatchewan, potential use of the FORCYTE model in mixedwood stands, and climatic aspects of white spruce stem wood biomass productivity.

STUDIES

Peatland development and ecology

Increasing wood production through forest land drainage

Development of integrated biomass prediction equations for the Western and Northern Region

Impact of climatic variation on boreal forest biomass production

An assessment of the energy potential of forest biomass in the prairie provinces and Northwest Territories

Boreal forest risk factor modeling

1986-88 OBJECTIVES

To produce reports on the ecology of wetland development in the Western and Northern Region; to construct drainage ditch systems on two of the three experimental areas and to monitor changes resulting from these treatments; to develop a risk factor analysis for predicting losses from fire, insects, or diseases, initially at a local level; to oversee the conclusion of ENFOR contract studies and adapt ENFOR reports for publication.

PROJECT LEADER, PARTICIPANTS

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J.D. Johnson
Dr. T. Singh

M.W. Ali
E.B. Robson

FOREST RESOURCES RESEARCH

OBJECTIVES

To develop and assess silviculture treatments and options for increasing the yields of managed stands and to evaluate them in economic terms; to provide forest management agencies with improved techniques and models for growth and yield prediction for the commercially important cover types and management options on different sites in the prairie provinces and Northwest Territories; to evaluate, develop, and apply new remote sensing and interpretation techniques for forest inventories and environmental management purposes; to provide related technology transfer and advisory services.

ACCOMPLISHMENTS

Numerous long-term studies have been initiated in the past to obtain information on growth and yield of natural stands and on growth and yield following intensive silvicultural treatments. Such studies were also set up to develop guidelines and prescriptions for treatments such as spacing, thinning, and fertilization of lodgepole pine, jack pine, white spruce, and trembling aspen in the region. Results are published as they become available. Intensive short-term studies on tree and stand growth are also conducted to provide information and solutions for specific problems.

A paper was published on the impact of red belt on lodgepole pine growth in the eastern Rockies of Alberta. The lodgepole pine bibliography, initially prepared by Reid, Collins and Associates Ltd., was updated and published as an Information Report, ***Bibliography of lodgepole pine literature.***

In forest fertilization, a paper was published on distribution of nitrogen in a simulated profile of a Podsolic Gray Luvisol following urea fertilization. A detailed file report has been written that summarizes all information on the response of Coalspur and Mercoal soils to nitrogen, phosphorus, and sulfur mineral fertilization and their implications for operational application and on future research. Research is continuing to determine the response to thinning and fertilization of semimature lodgepole pine, to reassess nutrient status of needles as a diagnostic tool, and to assess fertilization trials in black spruce and jack pine in Alberta, Saskatchewan, and Manitoba.

An important activity in growth and yield was continued through leadership and administrative support of the regional growth and yield cooperative, whose main objective is to provide an opportunity for people working on similar problems in growth and yield to meet and exchange ideas, decide on priorities, and share work and data.

A study (now in its third year) of stand tending techniques in the mixedwood forest utilizes unique long-term data of up to 50 years of observations. A report is being prepared on white spruce growth and yield after release from trembling aspen, incorporating data from recently relocated and remeasured plots in Manitoba and Saskatchewan and individual white spruce release response data from Alberta. Several demonstration tours and related technology transfer activities were conducted on white spruce release response.

Good progress has been made in the economic evaluation of some intensive forest management practices, and a report on economic returns from fertilizing 70-year-old lodgepole pine has been prepared, as has an analysis of the economics of spacing in overdense lodgepole pine and jack pine. A presentation on market potential for Alberta poplar products was made at the 1987 joint

meeting of the Canadian and American poplar councils.

In the study to develop managed stand yield tables for lodgepole pine and white spruce, good progress has been made on data verification, cleaning, reformatting, and identification of data gaps and redundancies. Suitable software has been developed. Height growth curves have been developed that include elevation and density effects. Two models to forecast stand growth and yield are being developed: 1) a simple, but biologically sound, stand level model, and 2) a single-tree distance-independent simulation model similar to Arnie's Stand Projection System (SPS).

In forest inventory activities, high-resolution airborne digital data is being analyzed for generating enhancements to facilitate species discrimination in boreal mixedwood forests, and a paper on Canadian large-scale aerial photographic systems was accepted for publication. A study was initiated with Alberta Forestry, Lands and Wildlife to determine the optimum specifications for film exposure and processiong for forest interpretation using large-scale photography. Other inventory activities included evaluation of large-scale photo capabilities for sampling regeneration stocking in Saskatchewan in cooperation with Weyerhaeuser through Canada-Saskatchewan agreement funding to Dendron Resource Surveys; and interpretation, fieldwork, and data compilation for evaluating the accuracy of mapping cutovers from Landsat Thematic Mapper and Multispectral Scanner imagery in relation to cutover size.

STUDIES

Data-base development for growth and yield of important forest types in the prairie provinces

Analysis of growth and yield of important tree species in the prairie provinces

Transformation and movement of applied fertilizer elements (N, P, S) in selected lodgepole pine stands

Interpretation and mapping

Fertilization and thinning of semimature lodgepole pine stands

Development and application of large-scale photo and image analysis techniques to forest inventories

Economic evaluation of intensive forest management practices

Stand tending techniques in the mixedwood forest section

[illegible]

To conduct research, development, and technology transfer activities in growth and yield, intensive cultural treatments, and in remote sensing and interpretation; to provide technical input and leadership in the regional growth and yield cooperative; to remeasure jack pine commercial thinning and the jack pine, red pine, and white spruce spacing trials in Manitoba; to analyze jack pine thinning data and prepare a Forest Management Note; to prepare a report on white spruce tree and stand growth after release from aspen and to assess growth and yield of white spruce-trembling aspen stands in relation to species mix and other variables; to prepare guidelines or prescriptions for spacing and thinning lodgepole pine in

Alberta; to develop tree and stand level yield forecasting models for lodgepole pine and white spruce; to prepare a journal paper on western gall rust dynamics and impact; to prepare a journal note on the nutrient status of 40-year-old lodgepole pine needles; to prepare a a journal paper on economic returns from fertilizing 70-and 30-year-old lodgepole pine; to prepare a report on the economics of spacing dense lodgepole pine; to coordinate and demonstrate ER-2 high altitude panoramic natural resource data acquisition through the U.S. Forest Service Nationwide Forestry Applications Program and the Canada–Alberta development agreement; to compare data on cutover areas obtained from Landsat Thematic Mapper and Multispectral Scanner imagery with existing methods using aerial photography; to determine optimal exposure/processing parameters for large-scale photography for forest inventory; to continue methodology developments for digital image enhancements with high resolution MEIS II data for cover type mapping.

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Dr. R.C. Yang

D.H. Carrigan
(From Nov. 1987)
S.J. Lux
R.D. Patterson
(From May 1987)

Objectives

To promote the development and dissemination of silvicultural knowledge and its application, particularly in the area of forest regeneration and plantation management; to maintain effective consultation and liaison with resource managers and other researchers regionally and across Canada; to undertake silviculture research and development, particularly in the areas of ecological site classification and site productivity, effects of mechanical site treatment on soil properties and seeding and planting chance and subsequent plantation development, field performance of stock and guidelines for their use, causes of early mortality in young softwood plantations, and effects and costs of various vegetation management techniques aimed at improving establishment and growth of new forest crops.

Accomplishments

Research and technology transfer activities continued in the areas of regeneration silviculture, vegetation management, forest ecology and site productivity, early plantation development, and site classification.

Regeneration silviculture work included completion of the 8-year plantation performance project at Grande Prairie, continuation of coordinating and silviculture research and development roles in forest resource development agreement-funded vegetation management work, region-wide site preparation trials and technology transfer activities through the Regional Reforestation Technical Committee and through personal contact. Planning, including client interviews, was begun on a new multidisciplinary study in mixedwood management, with emphasis on both conifers and hardwoods.

Work in forest ecology and site productivity has included a major technology transfer emphasis on the west-central Alberta biogeoclimatic field guide through presentation of four workshops and a major seminar. Research continued in the areas of manageable factors relevant to site productivity, and reporting proceeded on cutover succession studies and on effects of soil compaction on tree growth. There was substantial involvement in site classification work, including supervision of a methodology study in Manitoba, provision of classification expertise to research projects at Hinton and Fawcett Lake, and editorial work on site classification reports generated by the national Site Classification and Land Evaluation committee (SCALE). As well, a site classification paper was presented at an International Union of Forestry Research Organizations conference in Finland.

A major accomplishment was the publication of *Tree and shrub insects of the prairie provinces*, by W.G.H. Ives and H.R. Wong. This is a landmark publication in the field of forest entomology. Work also progressed on a study of causes of mortality in lodgepole pine and jack pine stands in Alberta and Manitoba that emphasizes the life table approach to stand development, a subject of considerable interest as progress is made toward more-intensive management of the species.

The project provided the chairman for the CFS national working group on forest site classification (SCALE) and presented a management symposium on that subject. There was continued technology transfer activity regarding site classification methodology directed to both industrial and provincial government clients.

STUDIES

Silvicultural investigations

Evaluation of mortality in stands of young trees in plantations and scarified areas

Control of vegetation in managed forests

Forest ecology and site productivity

Forest vegetation management techniques and tools for forestry

Soil amelioration in boreal forests

Technology transfer in site classification and forest soils

TERM OF REFERENCE

To maintain regional research, development, and technology transfer activities in the demonstration and evaluation of silvicultural equipment, vegetation management, seedling field performance, forest site classification and land evaluation, site productivity, and cumulative mortality studies in pine; to develop contracts and act as scientific authorities for contracts under the federal-provincial forestry agreements, including vegetation management, site classification, and evaluation and forest management demonstrations; to cooperate with regional and national groups such as the Regional Reforestation Technical Committee, CFS Weed Management Working Group, Expert Committee on Weeds, CFS Mechanization of Silviculture Project, Silviculture Subcommittee of the Forest Engineering Research Institute of Canada, Forest Pest Management Institute, and the Canadian Forest Resource Data Program.

PROJECT LEADER

L.G Brace

Dr. I.G.W. Corns
W.D. Holland
W.G.H. Ives
M.E. Upton
(Resigned Nov. 1987)

D.T. Allan
J.R. Gorman
C.L. Rentz
P.B. Todd

NURSERY MANAGEMENT
TREE IMPROVEMENT

OBJECTIVES

To formulate planning tools and guidelines for promoting improved standards for management of regional forest nurseries, particularly in the areas of bare-root and containerized seedling production, handling, storage, seed and seedling physiology, and cold tolerance; to produce genetically improved grafts, seed, seedlings, and rooted cuttings of jack pine in sufficient quantity to facilitate mass production by regional cooperators; to continually increase the degree of genetic improvement in jack pine and contribute knowledge on genetic variation in forest tree species; to use ecosystem models, where applicable, to assist regional clients in forest ecosystems management.

ACHIEVEMENTS

Dormancy and cold hardiness testing of lodgepole pine, jack pine, white spruce, and black spruce continued, and data are being analyzed. Research in accelerated growth and promotion of early flowering and cone and seed production in lodgepole pine, jack pine, white spruce, and black spruce continued. Outplanted lodgepole pine and white spruce were severely damaged by frost in a late winter snowstorm, and replacement crops of both species were grown for outplanting in 1988. First-year performance of jack pine was monitored, and black spruce received greenhouse treatments of varied light, photoperiod, and growth regulators prior to being outplanted for further observation. Technical advice was provided to the Manitoba Forestry Branch in support of a Canada–Manitoba Forest Renewal Agreement project to grow large black spruce stock at the Pineland Nursery. A study to establish size class standards and develop methods of monitoring stock quality in Saskatchewan continued. Morphological and physiological data have been collected, compiled, and entered on computer. Data analysis for the experiment to determine the effects of fertilizer inputs on residual fertility has been completed. A study on the effects of fertilization on hardening off of containerized red pine and Scots pine was completed, and data analysis is in progress.

Soil and plant analyses and advice were provided to provincial and industry nurseries. A workshop on forest nursery management was conducted in Winnipeg for Manitoba Forestry Branch personnel under sponsorship of the Canada–Manitoba Forest Renewal Agreement. There was participation on the national committee of the Canadian Tree Nursery Weed Control Association, and contributions were made to the drafting of its constitution and in reviewing the design of a national trial of oxyfluorfen (Goal) in tree nurseries. Papers on cold hardiness, stock viability, photoperiod and light effects, fertilization frequency, and nutrient prescriptions were presented at meetings of the Canadian Society of Plant Physiologists and the Prairie Federal–Provincial Nurserymen.

Application of the FORCYTE growth simulation model to an aspen ecosystem was aided by development of a driver program (PROBE), and a user's manual was prepared. PROBE facilitates repeated computer runs of the model by automatic substitution of user-specified values for different parameters. There was collaboration with a contractor in developing a protocol for sensitivity analysis of portions of the model. Contact was maintained with other Canadian users of FORCYTE by presenting workshops and through lead participation in an aspen ecosystem was a FORCYTE Strategy/Planning Meeting held at the Northern Forestry Centre to review past and current FORCYTE activities and to set priorities for continuing development. Two papers on PROBE and FORCYTE were presented at

an International Union of Forestry Research Organizations conference on "Forest Growth Modeling and Prediction". Application of FORCYTE-11 to boreal aspen and aspen-mixedwood management was initiated through a contract to determine mixedwood management problems and, at a later date, to evaluate the potential of this modeling framework to solve the problems.

The black spruce provenance test plantation was tended, and data from all three breeding districts have been analyzed. A paper on selection and mating strategies in conifer tree improvement programs was presented at the 1987 meeting of the Canadian Tree Improvement Association. An experimental design and field layout for testing genetic gain in the eastern breeding districts was completed, and the family test plantation has been thinned. There was minimal tending of the Chip Lake clone bank; no further planting will be done, and minimum maintenance will be conducted.

STUDIES

Forest tree seed and seedling physiology

Provenance tests for coniferous species

Breeding jack pine for the northern region

Forest nursery research and technology transfer

Greenhouse and nursery operations

Nursery soil fertility and seedling growth

Ecosystem and nutrient cycling modeling

1988-89 OBJECTIVES

To continue cold hardiness and dormancy tests and continue study of accelerated growth and early flowering in five conifer species; to investigate greenhouse and nursery problems and continue the study on establishment of size class standards and monitoring stock quality; to prepare manuscripts on residual fertility in nursery seedbed and on fertilization for hardening off; to provide advisory services in soil fertility and seedling nutrition; to transfer documentation for terminated provenance tests; to plan an experiment to test genetic gain through mass selection and selection based on family test results; to provide functional guidance for development of jack pine seed orchards under the Canada-Manitoba Forest Renewal Agreement; to assist in sensitivity analysis of the FORCYTE-11 model and to plan and initiate its application to aspen and aspen-mixedwood management.

PROJECT LEADER

Dr. I.K. Edwards

STAFF

Dr. M.J. Apps
Dr. I.J. Dymock
E.M. Harvey
(Resigned Aug. 1987)
Dr. J.I. Klein
P.B. Chapman
F.M. Dendwick
W.M. Mills
J.J. van Dyk

FORESTRY EXTENSION AND PLANNING

FIRE [illegible] AND GUIDELINES

OBJECTIVES

To provide guidelines and standards to resource managers that will reduce, at an acceptable cost, the impacts of forest fires while considering the related economic, ecological, environmental, and social factors; to develop fire behavior guides for regional fuel types and incorporate them into the Canadian Forest Fire Danger Rating System; to elucidate the natural role of fire and describe fire effects on forest ecosystems; to provide precise information on air tanker performance, fire retardant performance and effectiveness, retardant drop patterns, improved fire-line productivity, and fire detection systems and methodology; to develop, test, and promote the application of models simulating various suppression activities at the field operational level and directed toward improved utilization and effectiveness of funds, manpower, and equipment.

ACHIEVEMENTS

Publications were completed on jack pine in Manitoba, Saskatchewan, and Alberta and on regeneration, burning, biomass, fire behavior, and related topics.

Additional work was completed on seen-area mapping, scanner trials, an ignition study, and evaluation of a new scanner and analyzer. The new equipment was used in both detection and behavior measurement modes.

New equipment and suppression techniques were evaluated, including application of foam, which was found to be very promising. The U.S. Operational Retardant Evaluation project was examined for the possibility of conducting a similar process in Canada.

Several papers were prepared on the fuel-biomass work completed in Jasper National Park. Two major reports on forest fire environment and forest fire management were forwarded to Pukaskwa National Park personnel. Five successful point source fires were documented for the Big Fish Lake experimental burning area.

Computer-assisted activities centering around artificial intelligence and expert systems are continuing to grow. Increased need and interest in this area has provided strong support for the activities.

STUDIES

Fire behavior in boreal forest fuels

Evaluation and development of fire detection-suppression technology

Evaluation of the role of fire in forest and intermingled vegetation in the prairie provinces, Rocky Mountains, and far north

Decision-aid models for use in fire management

Fire danger and behavior rating in forest and rangeland environments

Prescribed fire in forest and rangeland management

Northern Forestry Centre forest fire research coordination

1986-87 SCIENTIST YEAR

To conclude several additional papers on jack pine and fire for Alberta and Saskatchewan studies; to publish several papers based on thesis results on forest fuels in Jasper National Park; to assist with a comparative evaluation of retardants program and development of infrared scanning techniques for studying prescribed fires; to revise and finalize a regional fire research strategy and conduct an annual regional fire research technical subcommittee meeting; to publish the annotated bibliography of CFS fire research in the prairie provinces and NWT; to continue the experimental burning in the Big Fish Lake area; to complete a report on the Porter Lake experimental burning project; to determine the direction of the fire ecology study area; to develop expert systems on a local basis; to adapt and test Ryan's WNDCOM model for predicting winds in mountainous terrain; to complete theses on "Application of expert systems for dispatching initial attack resources to wildfires" and "Acceleration of point source fires to equilibrium spread from ignition."

PROJECT LEADER

Dr. R.J. Barney

M.E. Alexander
Z. Chrosciewicz
B.S. Lee
R.S. McAlpine

M.E. Maffey
C.J. Ogilvie
R.M. Smith

To provide forest management techniques to improve water yield from Alberta's Eastern Slopes forests; to investigate and evaluate the effects of traditional and nonstandard forest clearing practices on soil moisture and microclimate as they affect regeneration, establishment, production of fiber, and rotation duration; to evaluate the effects of events such as insect and disease damage, forest fires, and forest clearing activities on local water yield, regime, and quality.

A preliminary design was prepared for a clear-cutting scheme to increase the water level in Kenosee Lake in Saskatchewan. A user-friendly version of the WRENSS (Water Resources Evaluation of Nonpoint Silvicultural Sources) procedure was prepared for IBM PCs. Lectures were presented across Canada on the WRENSS procedure and the Alberta Watershed Research Program to acquaint forest and water resource management agencies of this procedure's potential to assist them in their day-to-day operations.

Several project staff were actively involved in major functions: organizing the Canadian Hydrology Symposium—88, the International Association of Hydrological Sciences Symposium on Forest Hydrology and Watershed Management, and the 1988 Western Snow Conference meeting, and participating as 1987–88 National Lecturer in Hydrology in the Canadian Water Resources Association and National Research Council's Associate Committee on Hydrology annual lecture tour.

Transfer of technology derived from the Alberta Watershed Research Program, 1963–86

Vegetation manipulation—disposition of snow in forest clearings

To continue to provide forest managers with practical management prescriptions and guidelines that will stabilize or improve the quantity, quality, and delivery time of water from forested areas; to investigate and evaluate the effects of traditional and nonstandard forest clearing practices on soil moisture and microclimate as they affect regeneration, establishment, production of fiber, and rotation duration; to install HSPF (Hydrologic Simulation Program FORTRAN) simulation model on the Northern Forestry Centre's VAX computer and conduct calibration runs with Marmot Creek (Twin subbasin) data.

PROJECT LEADERS

Dr. R.H. Swanson

Dr. P.Y. Bernier
(Resigned Dec. 1987)

Z. Fisera
P.A. Hurdle

Description

To provide computing and computing-related services, office automation advice, telecommunications advice, financial system assistance, mapping and statistical service and assistance, computer education, networking, and computer capital coordination.

Achievements

Advice, assistance, programming help, system analysis, evaluations of PCs, data entry, and training were provided during the year, as required. These services included PC advice, purchase, and set-up and introductory courses on the PC and VAX systems. A consultant was hired to evaluate the Northern Forestry Centre's computing needs for the next 5 years. Based on a questionnaire and selected staff interviews to obtain information on present and anticipated use, the consultant recommended expansion of both VAX and PC systems. As a result, the VAX 11/750 was upgraded to a VAX 8350 and a new PC network was installed.

Support for computer modeling has been provided to three different researchers on a trial basis, with encouraging results.

Study

Computing and data processing services

1988-89 Objectives

To continue to supply and expand computing and data processing services to fill the needs of the Northern Forestry Centre and its district offices; to assist with the DEVMIS (Development Management Information System) programs for management of the federal-provincial forestry agreements; to provide services in all aspects of office automation, communications, computing equipment selection, computing education, and other computer-related fields.

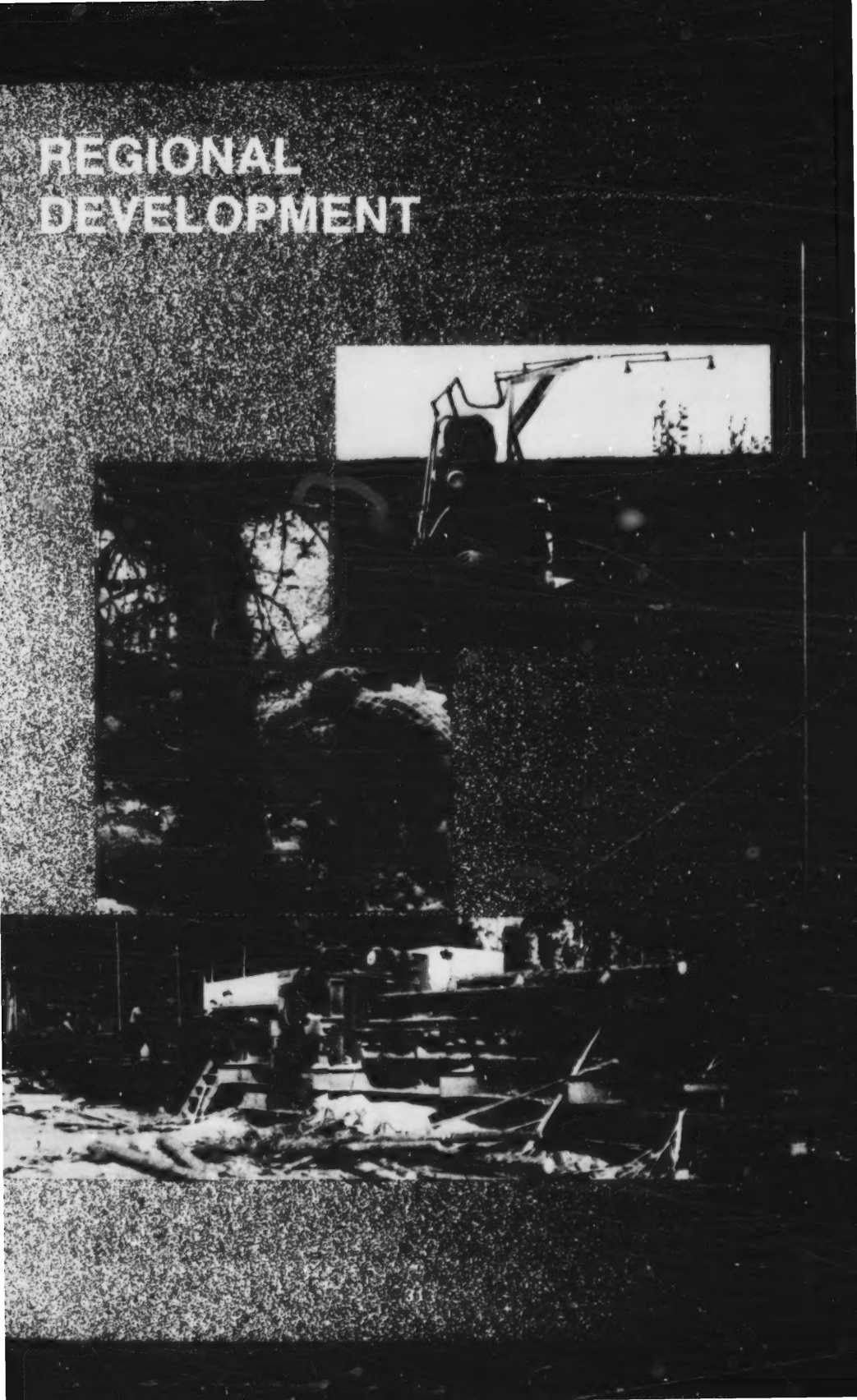
Project Leader

W. Chow

A.W. Irwin
A.J. Paradis

L. Hai

REGIONAL DEVELOPMENT



FORESTRY ECONOMICS

OBJECTIVE

To provide socioeconomic information to regional forestry programs for rational policy formulation and program development by identifying and estimating the major economic benefits, product flows, and impacts of the forest resource and its utilization in the Western and Northern Region; to provide input to regional forestry programs by participating in interdisciplinary studies; to provide economic statistics and guidelines on costs and benefits of the forest resource, impacts of forest management, marketing, and related socioeconomic data; to collect and interpret forestry statistics at the regional and national levels in order to provide advice and guidelines to resource managers and researchers in support of forest policy decision making.

ACHIEVEMENTS

Contract supervision was initiated for creating an uncertainty model and evaluation framework for intensive forest management decisions, a socioeconomic attitudinal survey of Alberta woodlot owners, and a study determining forest values for strategic fire response in Manitoba.

Assistance was provided in the development and implementation of various interdisciplinary forest economic/silvicultural studies to provide operational guidelines for cost-effective use of funds in intensive forest management under the Manitoba, Saskatchewan, and Alberta forestry development agreements. Continued assistance was given to evaluation task forces for the Manitoba and Saskatchewan agreements, and the terms of reference framework was prepared for the Alberta agreement.

The northern region component of the 1986 national forest inventory (part of the Canadian forest resource data program) was completed. Policy and program documentation were prepared and program descriptions were developed for an extended Alberta agreement, western diversification initiatives, and an Alberta farm woodlot program. Initial planning activities were undertaken for the national forestry economics project. Data from the *Directory of secondary woodusing industries in Alberta 1986* were analyzed and summarized.

STUDIES

Forestry and socioeconomic statistics and analysis/DEVMIS

Forestry resource economics and statistics research and coordination

Forestry development and fire management economics

Economic analyses of forest management practices

FIELD COLLECTION

To assist in the development and implementation of various interdisciplinary forest economic and silvicultural studies to provide

operational guidelines for cost-effective use of funds in intensive and extensive forest management; to participate in evaluation programs in Manitoba, Alberta, and Saskatchewan; to participate in the studies of the national forest economics program; to provide socioeconomic and statistical data, analysis, and documentation for policy and program development; to continue to provide input to the Canadian forest resource data program (national inventory and permanent sample plots); to prepare a landmark 10-year silviculture statistics Information Report; to develop a user's package for the permanent sample plots catalogue.

D.M. Boylen

J.P. De Franceschi
D.H. Kuhnke
T.B. Williamson

R.A. Bohning

[illegible]

[illegible]

To implement federal–provincial forestry development agreements in Alberta, Saskatchewan, and Manitoba; to assess the impact of regional, national, and international economic and social events on regional development of the forestry sector; to assist the development and implementation of forestry-related job creation programs in the prairie provinces and Northwest Territories, and to assist in the development of other forestry-related federal initiatives, as required.

CANADA-MANITOBA [illegible] RENEWAL AGREEMENT (Manitoba Districts)

ACHIEVEMENTS

The two major forest industry companies in the province completed a variety of reforestation projects during the year, including site surveys, scarification, seeding, and planting. Cost-shared funding was provided to the Manitoba Forest Inventory group for the purpose of loading the geographic information system. Approximately 200 townships in the southeastern corner of Manitoba have been completed, and another 84 are in progress. The next area to be addressed will be the northwest corner of the province, including Manfor's forest management lease.

The Canadian Forestry Service was involved in 13 community fairs during the year and made an estimated 50 000 visitor contacts. Workshops were held on nursery management, stand tending, and geographic information systems. A committee of four independent forestry specialists representing university, industry, and federal and provincial governments reviewed the work done under the Canada-Manitoba Forest Renewal Agreement. A report produced in 1987 covered the work done during the first 2 years of the agreement and makes recommendations for the remaining 3 years as well as provides recommendations for future agreements.

Container seedling performance was assessed in various regions of the province. An experimental design and layout was prepared for the Abitibi forest management lease, and stock site trials will commence next spring.

Jack pine budworm investigations continued, including assessment of possible relationships between budworm counts and defoliation intensities, assessment of cumulative and current defoliation in 330 plots, continuation for the 2nd year of a phenology study, and assessment of population levels. Major pest outbreaks were mapped, and pest surveys were conducted in young plantations and high-value stands.

A program of fire research was implemented that included organizing two fire behavior prediction workshops for provincial government and industry personnel, initiation of an analysis of fire weather and behavior associated with the Wallace Lake wildfire, completion of a fire occurrence data base for 1968–86, and completion of a poster on fuel types.

Tree improvement activities included preparation of an establishment report for the northern mass selection seed orchard, extraction of pedigree seed at Hadashville

for the eastern breeding district, development of a pedigreed seed orchard site at Oak Bank, a major thinning and selection program in the eastern breeding district, and establishment of the Interlake mass selection seed orchard with 22 000 jack pine seedlings.

STUDIES

Yields of managed stands: releasing white spruce from trembling aspen

Forest pest management, surveys, and damage appraisal

Fire management

Regeneration: hare damage assessment and technology transfer

Establishment of jack pine seed orchards in Manitoba

Forest site classification

Forest nurseries

Forest economics

Forest inventory

Tree improvement

Silviculture research and technology transfer

Forest renewal and intensive forest management

1988-89 OBJECTIVES

To manage and report on activities funded under the Canada-Manitoba Forest Renewal Agreement; to consult, liaise, review, monitor, and report on activities funded with federal funds under the cost-shared programs of the Canada-Manitoba Forest Renewal Agreement; to review the technical aspects of the federal forestry-related job creation programs.

CANADA-ALBERTA FOREST RESOURCE DEVELOPMENT AGREEMENT AND DEVELOPMENT PROGRAM COORDINATION (Northern Forestry Centre)

ACHIEVEMENTS

Reforestation activities included work on both provincial Crown lands and on Indian reserves as crews carried out reforestation surveys, stand establishment surveys, site preparation, tree planting, stand maintenance, and the development of forest management plans for Indian bands.

Forest products research and development, carried out under contracts, concentrated on the development and testing of panelboards, the production of new wood products made with aspen-poplar, and various market studies and technical seminars for the forest industry.

Forest research work included the continuation of a vegetation management study, a wetland drainage study, an economic timber supply model for Alberta, the development of a permanent sample plots catalogue for the prairie region, and the establishment of a mountain pine beetle hazard rating system.

Studies

Forest vegetation management: silviculture assessment of selected methods of site preparation and crop release in areas designated for softwood production in Alberta

Forest vegetation management: control of aspen development in areas designated for softwood production in Alberta

Forest vegetation management: environmental impacts and residue chemistry of forestry herbicides

Forest pest management and damage appraisal

Wetland drainage

Forest vegetation management: cost-effective strategies for vegetation management in areas designated for softwood production in Alberta

Tree improvement

Managed stand yield tables for lodgepole pine and white spruce

Forest economics, statistics, and timber supply modeling

Canada-Alberta public information subprogram

Demonstration project

Boreal risk factor modeling

[redacted]

To review socioeconomic events regionally, nationally, and internationally and assess impacts in terms of the Canadian Forestry Services's mandate and programs in relation to regional development in the forestry sector; to develop, implement, and administer projects under federal forestry-related job creation programs; to commission an evaluation of the Canada-Alberta Forest Resource Development Agreement; to coordinate federal forestry economic development activities with other federal government agencies, provinces, universities, forestry companies, and other interested groups; to ensure the successful development, funding, and implementation of forestry agreement projects within Alberta, Saskatchewan, and Manitoba relating to a) development and maintenance of timber supplies sufficient to ensure the long-term viability of the forest industry in the prairie provinces, b) efficient utilization of both softwood and hardwood forest resources, and c) economic development and diversification of provincial economies as well as improvement of employment and human resource development opportunities in the forestry sector.

ACTIVITIES

The forest renewal and growth enhancement program was involved in over 20 projects with the forest industry and Indian bands, over 75 private woodlot management proposals, approval of multiyear operational plans for four major companies, and implementation of silvicultural equipment trials. A framework was prepared for evaluation of the Canada–Saskatchewan Forest Resource Development Agreement, which expires in 1989. The program of forest mensuration research included development of a site index system for Weyerhaeuser, evaluation of growth simulation models such as SPS (Stand Projection System) and TWIGS (The Woodman Ideal Growth Projection System), assessment of volume equations used in Saskatchewan, and provision of assistance to clients interested in geographic information systems.

In silviculture, a large field trial tested six scarification implements and two stock types, recommendations of the Industrial Forestry Service Ltd. stock handling report were implemented, and advice and guidance were provided to provincial government personnel. A review of tree seedling cultural regimes at Saskatchewan nurseries was conducted. Fire research activities included an economic evaluation of the Elan fire, provision of instruction to the National Indian Forestry Institute and the Northern Institute of Technology, and supervision of five contracts. A public information program was delivered consisting of displays at four major exhibitions, production of a video on the forestry development agreement, preparation of a series of forestry pamphlets, and coordination of media releases.

STUDIES

Forest mensuration research

Fire management

Silviculture investigations

Forest nursery investigations

Stem injection of residual aspen

Crop tree and vegetation response to various vegetation control treatments in boreal-mixedwood sites in Saskatchewan

Forestry public information

Insect and disease investigations

Forest economics

1988-89 OBJECTIVES

To manage and report on activities funded under the Canada-Saskatchewan Forest Resource Development Agreement; to consult, liaise, review, monitor, and report on federally funded activities under cost-shared programs of the forestry development agreement; to advise other federal departments or agencies responsible for delivery of federal job development programs related to forestry; to deliver a program of forest mensuration research in Saskatchewan and to provide advisory services and technology transfer; to implement a program of silvicultural investigations through applied research, advisory services, technology transfer, field trials, reports, and surveys; to provide advice on vegetation management through technology transfer, liaison, and provision of advisory services; to provide a program of forestry public information, including media tours, ceremonies, feature articles, publications, news releases, and public relations; to carry out pest management and damage appraisal activities and provide advisory services through technology transfer; to foster new and improved uses of aspen; to accelerate new efforts in private woodlot management.

PROJECT LEADER PROFESSIONAL

H.S. Price

R.M. Côté
J. Mrklas
M.E. Stephen
(From Oct. 1987)

C.M. Abma
(From April 1987)

Objective

To plan, implement, and manage a work program designed to meet the forestry development needs of governments, private industry, universities, and other agencies in the prairie provinces and Northwest Territories; to establish and maintain effective working relationships with resource management agencies in the region; to participate in the development of policy and program priorities at regional and national levels; to provide effective managerial, administrative, financial, and other services to the regional development program.

Accomplishments

Over 200 projects were developed and initiated for three forestry development agreements. Proposals were developed for submission to the western diversification program. Forest economics research and economic intelligence and statistics gathering continued.

Studies

Management of regional development program

Publications

Objective for 1988-89

To incorporate the agreements into federal-provincial delivery systems; to manage the portfolio under guidelines received from the Canadian Forestry Service's Development Branch, including projects under the agreements that are functionally directed elsewhere; to continue the development and implementation of employment stimulation programs in the forest sector within existing constraints.

Project Leader

Dr. M.J. Heit

INFORMATION

INFORMATION

OBJECTIVES

To coordinate and promote the planning and delivery of an effective information and technology transfer program in the Western and Northern Region; to provide relevant and timely information to a diverse audience including scientific, technical, forest industry, business groups, and general public at a reasonable cost, using a variety of communications avenues (media, publications, personal contact, audio-visual presentations) and other available information; to provide scientific and technical editing and publishing services; to provide a full range of library and photographic support services to NoFC personnel and district offices.

ACHIEVEMENTS

The public information season was initiated with the Edmonton Sportsman's Show and Sherwood Park Trade Fair. National Forest Week activities throughout the region and the major exhibition circuit attracted more than 125 000 visitors to Northern Forestry Centre (NoFC) and Manitoba and Saskatchewan district office display booths during the summer months. Project staff also presented information exhibits at the Alberta Forest Products Association's annual meeting at Jasper and the Alberta Science Teachers' Council annual conference and participated in public tours of NoFC facilities. In cooperation with the Alberta Forest Service under the Canada-Alberta Forest Resource Development Agreement, the mobile exhibit trailer depicting "Alberta's Managed Forests" was operated throughout northern Alberta, where it attracted 33 000 visitors during the 1987 summer operating season.

In 1987-88, 57 publications were produced, including Information Reports, Program Review 1986-87, Forest Management Notes, journal articles, Pest Leaflets, and miscellaneous publications (Appendix E). Project staff continued to respond to requests for publications and general forestry information. The continued services of a graphic artist (term) aided in the production of exhibits and other published materials.

The library continued to provide a full range of services and completed expansion to alleviate space and shelving limitations. Recently acquired photographic and processing equipment has enhanced the color production and print-making capabilities of the photo section.

STUDIES

Scientific and technical editing and publishing

Public information and media relations

Library services

Technology transfer and extension

[redacted]

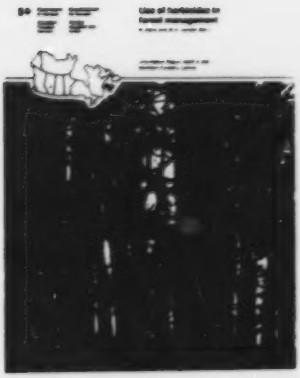
To maintain the established levels of public information and technology transfer activities; to continue to implement communications subprogram activities under federal-provincial forestry agreements; to complete a retrospective evaluation of NoFC research and development applications; to participate in the organization, conduct, and publication of proceedings of a major technology transfer symposium on mixedwood management; to assist staff in the preparation, publication, and distribution of scientific, technical, and public information; to provide a full range of library and photographic support services; to implement the Sydney automated library management system.

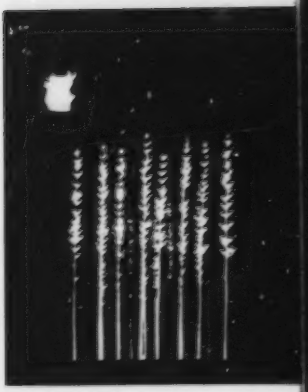
[redacted]

R.G. Newstead

A.C. Ascher
B. Boughton
D.J.S. Robinson
J.K. Samoil

D.J. Adams
(Resigned Jan. 1988)
P.S. Debnam
E.M. Hopp
D.D. Lee
D.A. Leroy
(From Sept. 1987)
H.M. Stewart





MANAGEMENT SERVICES

[redacted]

[redacted]

To provide a system of financial control and accountability in accordance with statutory and regulatory requirements; to provide general administrative support services, including materiel management, records management, engineering, building maintenance, secretarial and office services, and vehicle fleet management.

[redacted]

A second chemical storage facility was constructed to provide safe and secure storage of hazardous substances. A charge-back system for long distance telephone calls was implemented.

[redacted]

Financial services
Management services
Administration
Materiel management
Building maintenance
Building operations
Electronics support
Camps
Vehicles
Safety

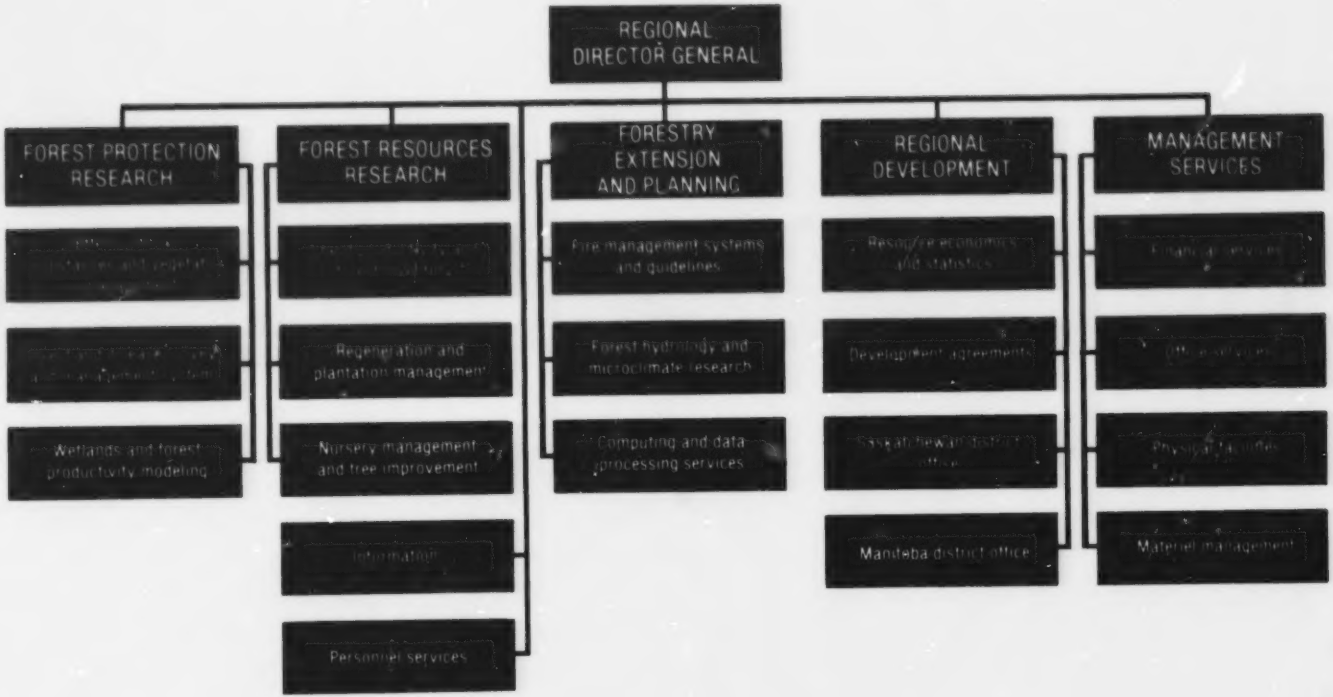
[redacted]

To continue to provide efficient administrative, materiel management, and financial support services.

APPENDIX A

NORTHERN FORESTRY CENTRE ORGANIZATION CHART

(As of March 31, 1987)



APPENDIX B

STAFF LISTING

(April 1, 1987, to March 31, 1988)

Regional Director General of Forestry:	A.D. Kiil Secretary—J. Palmer
Program Directors	
Forest Protection Research:	Dr. S.S. Malhotra Secretary—J. Palmer
Forest Resources Research:	R.M. Waldron Secretary—R.V. Bown
Forestry Extension and Planning:	Dr. J.M. Powell Secretary—R.V. Bown
Regional Development:	Dr. M.J. Heit Secretary—R.V. Bown
Regional Manager, Management Services:	P.G. Stewart Secretary—R.V. Bown

FOREST PROTECTION RESEARCH

Dr. S.S. MALHOTRA

Project	Title	Professional Staff	Technical Staff
NOR-7	Environmental effects of toxic substances and vegetation management	Dr. S.S. Sidhu [*Project leader*] J.C.Y. Feng Y.P. Kalra Dr. D.G. Maynard	M.D. Fairbarns C. Feng J. Hudson [*From Aug. 1987*] L.J. Milward [*Resigned July 1987*] F.G. Radford J. Shuya

Project	Title	Professional Staff	Technical Staff
NOR-11	Forest insect and disease surveys and management systems	Dr. H.F. Cerezke [*Project leader*] P.A. Amirault Dr. Y. Hiratsuka Dr. K.I. Mallett [*From July 1987*] Dr. W.J.A. Volney Dr. H.R. Wong	F.J. Emond H.S. Gates P.J. Maruyama G.N. Still D.L. Szlabey R.C. Tidsbury
NOR-28	Wetlands and forest productivity modeling	S.C. Zoltai [*Project leader*] Dr. G.R. Hillman J.D. Johnson Dr. T. Singh	M.W. Ali E.B. Robson

FOREST RESOURCES RESEARCH

R.M. WALDRON

NOR-4	Stand productivity and forest inventory	Dr. I.E. Bella [*Project leader*] Dr. J. Baker C. Cieszewski H.S. Grewal R.J. Hall W.C. Moore W.J. Ondro Dr. R.C. Yang	D.H. Carrigan [*From Nov. 1987*] S.J. Lux R.D. Patterson [*From May 1987*]
NOR-10	Regeneration and plantation management	L.G. Brace [*Project leader*] Dr. I.G.W. Corns W.D. Holland W.G.H. Ives M.E. Upton [*Resigned Nov. 1987*]	D.T. Allan J.R. Gorman C.L. Rentz P.B. Todd
NOR-12	Nursery management and tree improvement	Dr. I.K. Edwards [*Project leader*] Dr. M.J. Apps Dr. I.J. Dymock E.M. Harvey [*Resigned Aug. 1987*] Dr. J.I. Klein	P.B. Chapman F.M. Dendwick W.M. Mills J.J. van Dyk

FORESTRY EXTENSION AND PLANNING

Dr. J.M. POWELL

Project	Title	Professional Staff	Technical Staff
NOR-5	Fire management systems and guidelines	Dr. R.J. Barney [*Project leader*] M.E. Alexander Z. Chrosciewicz B.S. Lee R.S. McAlpine	M.E. Maffey C.J. Ogilvie R.M. Smith
NOR-13	Forest hydrology and microclimate research	Dr. R.H. Swanson [*Project leader*] Dr. P.Y. Bernier [*Resigned Dec. 1987*]	Z. Fisera P.A. Hurdle
NOR-53	Computing and data processing services	W. Chow [*Project leader*] A.W. Irwin A.J. Paradis	L. Hai

REGIONAL DEVELOPMENT

Dr. M.J. HEIT

NOR-3	Resource economics and statistics	D.M. Boylen [*Project leader*] J.P. De Franceschi D.H. Kuhnke T.B. Williamson	R.A. Bohning
NOR-36	Development agreements	H.S. Price [*Project leader*] R.M. Côté J. Mrklas M.E. Stephen [*From Oct. 1987*]	C.M. Abma [*From April 1987*]
NOR-54	Management of regional development program	Dr. M.J. Heit [*Project leader*]	

	Professional Staff	Technical Staff
Saskatchewan District Office (Prince Albert)	R.A. Fautley *[District manager]* W.J. de Groot A.C. Gardner C.A. Lee P.E. Loseth *[From Feb. 1988]* M.E. Newman A.F. Shortreid *[Resigned Dec. 1987]*	K.P. Bacon G.R. Barth C.M.A. Halland *[From Nov. 1987]* J.H. Johnston D.M. Sidders P.E. Taylor S.F. Urquhart
Manitoba District Office (Winnipeg)	J.A. McQueen *[District manager]* W.J. Ball N.M. Cataldo M. Daoust-Savoie K.G. Hirsch T.W. Steele *[Resigned Jan. 1988]*	B. Beaton L.I. Davies *[Resigned Sept. 1987]* J.R. Dyck M.G. Grandmaison V.S. Kolabinski A. Nanka B.I. Schlawitz S.M. Sokol N.R. Walker

INFORMATION

A.D. KIIL

Project	Title	Professional Staff	Technical Staff
NOR-33	Information	R.G. Newstead *[Project leader]* A.C. Ascher B. Boughton D.J.S. Robinson J.K. Samoil	D.J. Adams *[Resigned Jan. 1988]* P.S. Debnam E.M. Hopp D.D. Lee D.A. Leroy *[From Sept. 1987]* H.M. Stewart

MANAGEMENT SERVICES

P.G. STEWART

Position	Staff
Head, financial services	D.G. Benke
Finance officer	R.G. Cooper
Finance clerks	J.J. Iskra
	R.P. Owens
	L.A. Ross
Purchasing officer	J.E. Hodgins
	[Retired June 1987]
	G.R. Fawcett
	[From June 1987]
Purchasing clerk	T.Y. Avenell
	[Retired July 1987]
	M.K. Sampson
	[From July 1987]
Storesperson	G.R. Fawcett
	[To June 1987]
	A. Yohannes
	[From June 1987]
Vehicle clerk	J.L. Wake
	M.J. Keryliuk
	[From Nov. 1987]
Supervisor, office services	D.M. Burke
Records office supervisor	A.R. Fulton
Records clerk	M.K. Sampson
	[To July 1987]
Word processor operators	S. Ratansi
	E. Schiewe
	J.M. Simunkovic
Receptionist-typist	T.B. Phillips
Head, physical facilities	H. Schoendube
Chief engineer	R.J. Fisher
Maintenance engineers	A. De Costa
	W.B. Lybbert
Senior maintenance craftsman	S.T. Colistro
Maintenance craftsman	G.K. Burton
Groundskeeper	G.M. Schmidt
Assistant groundskeeper	R.N. Kasprick
	[Term to Sept. 1987]
Electronics technician	P. Bihuniak
	[Deceased May 1987]

PERSONNEL

(Agriculture Canada employees located at the Northern Forestry Centre)

Personnel advisor	R.P. Czuj
Pay and benefits clerk	B.M. Grauman
Personnel clerks	M.C. Grbavec
	E. Kuyt
	(From Mar. 1988)

APPENDIX C

EXPENDITURES 1987–88

Program area	Person-years	Salaries ($000)	Operations & maintenance[a] ($000)	Capital ($000)	Contributions ($000)	Total ($000)
Directorate	16.0	630.4	278.2	981.1	—	1,889.7
Management services	23.0	661.5	488.6	—	—	1,150.1
Forest protection	25.4	1,133.8	162.2	—	—	1,296.0
Forest resources	26.5	1,162.7	152.9	—	—	1,315.6
Forestry extension and planning	16.3	711.2	107.2	—	—	818.4
Regional development	14.6	557.2	63.5	—	—	620.7
ENFOR[b]	—	—	96.1	—	—	96.1
Manitoba agreement	10.5	376.1	517.1	110.4	1,392.7	2,396.3
Saskatchewan agreement	9.3	361.6	541.6	89.6	1,393.0	2,385.8
Alberta agreement	5.4	218.2	1,798.6	60.0	588.2	2,665.0
NOGAP[c]	--	—	49.0	—	—	49.0
Student employment program	—	132.8	—	—	—	132.8
Total	147.0[d]	5,945.5	4,255.0	1,241.1	3,373.9	14,815.5

[a] Includes contracts; see Appendix D.

[b] ENergy from the FORest, funded by Energy, Mines, and Resources Canada.

[c] Northern Oil and Gas Action Program.

[d] In addition, there are three Agriculture Canada Personnel employees located at the Northern Forestry Centre.

APPENDIX D

CONTRACTS LET OR SUPERVISED AND EXPENDITURES IN 1987-88

Contractor	Title	Amount ($)	Scientific authority
Canadian Library Association 602, 200 Elgin Street Ottawa, Ontario K2P 1L5	Provision of information retrieval services	2,700	D.J.S. Robinson
Carrigan, D. 104, 8800 - 99 Street Edmonton, Alberta T6E 1Y2	Software development for a lodgepole pine stand projection system	6,000	I.E. Bella
Dempster, W.R. & Associates 14011 - 101 Avenue Edmonton, Alberta T5N 0K2	Assessment of climatic change on the boreal forest	4,900	T. Singh
Digital Equipment 17107 - 107 Avenue Edmonton, Alberta T5S 1G3	FM-NTPLN-A1 network design and planning estimates	5,500	W. Chow

Continued on next page

APPENDIX D continued

Contractor	Title	Amount ($)	Scientific authority
Drouin, J.A. 11520 - 41 Avenue Edmonton, Alberta T6J 0V1	Finalize writing of report on herbicide efficacy trials in Alberta and Manitoba	2,200	L.G. Brace
Geode Creative Productions 9336 - 49 Street Edmonton, Alberta T6B 2L7	Production of two exhibition video tapes	1,344	A.C. Ascher
Higginbotham, K.O. 10435 - 27 Avenue Edmonton, Alberta T6J 4C6	Assessment of CO_2 enrichment on boreal forest	4,900	T. Singh
Hunt, S. & Associates 15 Glacier Place St. Albert, Alberta T8N 1R7	Conduct training course on chemical safety	3,200	P.G. Stewart
Johnson Forestry Services 419 Parkvalley Dr. S.E. Calgary, Alberta T2J 4V3	Review map catalogue; file and cross-reference 200 maps	5,000	R.M. Waldron

Kershaw, L.J. 51163 Range Road 204 Sherwood Park, Alberta T8G 1E5	Conduct vegetation studies of environmental effects of disturbance in subarctic	5,000	S.C. Zoltai
Kruger, A. 106, 10735 - 81 Avenue Edmonton, Alberta T6E 1Y2	Computer programming related to remote sensing	2,500	R.J. Hall
McCourt Management Ltd. Environmental Consultants 4244 - 91A Street Edmonton, Alberta T6E 5Y2	Research on effects of hexazinone on small mammals under field conditions	6,174	L.G. Brace
McIsaac, D. 10935 - 122 Street Edmonton, Alberta T5M 0A7	Preparation of plant tissue, organic and mineral soil for chemical analysis	7,700	D.G. Maynard
Noval Enterprises P.O. Box 2535 Calgary, Alberta T2P 2N6	Seed, fertilize, and grow 25 000 Colorado blue spruce to a height of 15 cm	3,850	H.S. Stewart

Continued on next page

APPENDIX D continued

Contractor	Title	Amount ($)	Scientific authority
Penner, M. 3528 West 11 Avenue Vancouver, B.C. V6J 2K2	Provide programming services for lodgepole pine stand development model	7,000	I.E. Bella
Sky High Productions 10424 - 68 Avenue Edmonton, Alberta T6H 2A9	Production of 20-minute video	1,060	A.C. Ascher
Têtu-Bernier, P. 1055 Rue du Peps Ste. Foy, Quebec G1V 4C7	Provide translation service for written documents	2,500	A.C. Ascher
Turtle, G. 102, 10708 - 79 Street Edmonton, Alberta T6E 1S3	Provide editing services	10,000	J.K. Samoil
University of Alberta (Dr. P. Kershaw) Department of Geography Edmonton, Alberta T6G 2H1	Study of environmental effects of disturbances in the subarctic	40,290	S.C. Zoltai

University of Alberta (Dr. P.J. Murphy) Department of Forest Science Edmonton, Alberta T6G 2H1	Survey private woodlot owners for attitudes to commercial development of their forest resources	5,000	D.M. Boylen

Canada-Alberta Forest Resource Development Agreement

Alberta Research Council P.O. Box 8330 Stn. F Edmonton, Alberta T6H 5X2	Development of procedures for the improved use of new binders in waferboard and strand board	67,200	J. Mrklas
Alberta Research Council P.O. Box 8330 Stn. F Edmonton, Alberta T6H 5X2	Load effects on stressed skin panels and waveboard	92,000	J. Mrklas
Deer Mountain Logging Ltd. 8 Hollinger Drive Swan Hills, Alberta T0G 2C0	Provide field trials of Silva Waddell Scarifier	37,000[a]	J.R. Gorman
Dempster, W.R. & Associates 14011 - 101 Avenue Edmonton, Alberta T5N 0K2	Develop priorized list of problems and needs of the regional growth and yield co-op	2,900	I.E. Bella

Continued on next page

APPENDIX D continued

Contractor	Title	Amount ($)	Scientific authority
Farrington, P. 10662 - 65 Street Edmonton, Alberta T6A 2P2	Establishment of field plots and collection and analysis of soil samples	8,500	S.S. Sidhu
Hayward, R. 8 Vardana Place N.W. Calgary, Alberta T3A 0C5	Establishment of field plots and completion of silviculture assessment	13,400	L.G. Brace
Lee, D. 201, 10235 - 121 Street Edmonton, Alberta T5N 2K6	Provide graphic arts services	5,000[a]	J.K. Samoil
Ligna Technologies Ltd. Box 1844 Leduc, Alberta T9E 2Z1	Conduct feasibility study for relocating or building particle board plant	20,000	R.M. Côté
McIsaac, D. 10935 - 122 Street Edmonton, Alberta T5M 0A7	Establishment of field plots and collection of and analysis of soil samples	8,500	S.S. Sidhu

Monenco Consultants 400 Monenco Place 801 - 6 Avenue S.W. Calgary, Alberta T2P 3W2	Selection, modification, and testing of insect and disease for forest yield prediction	11,000	T. Singh
Novacorp International P.O. Box 2535 Stn. M Calgary, Alberta T2P 2N6	Overwintering containerized seedlings using circulated heat	37,600	I.K. Edwards
Pelican Spruce Mills P.O. Box 2339 Drayton Valley, Alberta T0E 0M0	Test oriented strand board	8,675	R.M. Côté
Petty, J. 7427 - 77 Avenue Edmonton, Alberta T5T 0H9	Research, tabulate, map, and deliver a report on insect and disease infestation on forest lands	7,800	T. Singh
Silvacom Ltd. 9868A - 33 Avenue Edmonton, Alberta T6N 1C6	Development of a forestry data bank catalogue and archives	30,000	M.J. Heit

Continued on next page

APPENDIX D continued

Contractor	Title	Amount ($)	Scientific authority
Silvacom Ltd. 9868A - 33 Avenue Edmonton, Alberta T6N 1C6	Electronic data collection for permanent sample plots	4,500	P.A. Amirault
University of Alberta (Dr. P.J. Murphy & Dr. P.M. Woodard) Department of Forest Science Edmonton, Alberta T6G 2J9	Report on fire line productivity in selected fuel types for hand crews and motorized equipment	19,955	R.J. Barney
Western Archrib P.O. Box 5648 Edmonton, Alberta T6C 4G1	Report on design values for small Westlam	15,020	R.M. Côté
Western Archrib P.O. Box 5648 Edmonton, Alberta T6C 4G1	Westlam product acceptance and market development	48,700	R.M. Côté
Canada-Saskatchewan Forest Resource Development Agreement			
Berlin Contracting Box 47 Smeaton, Saskatchewan S0J 2J0	Site preparation with a TTS Delta	9,600	D.M. Sidders

Black, L. Box 202 White Fox, Saskatchewan S0J 3B0	Site preparation with a D-6 Crawler	4,950	D.M. Sidders
Deer Mountain Logging Ltd. 8 Hollinger Drive Swan Hills, Alberta T0G 2C0	Provide field trials of Silva Waddell Scarifier	58,000[b]	J.R. Gorman
GeoData Systems Ltd. Suite 40, 2100 Broad Street Regina, Saskatchewan S4P 1Y5	Aerial photography	2,700	D.M. Sidders
Lee, D. 201, 10235 - 121 Street Edmonton, Alberta T5N 2K6	Provide graphic arts services	5,000[b]	J.K. Samoil
Slyziuck, Vic Construction Ltd. R.R. 1 Gilbert Plains, Manitoba R0L 0X0	Site preparation with a TTS Delta/D-7	10,125	D.M. Sidders
Woodlands Enterprises Ltd. P.O. Box 1060 Prince Albert, Saskatchewan S6V 5S6	Site preparation with a Bracke Mounder	8,500	D.M. Sidders

Continued on next page

APPENDIX D continued

Contractor	Title	Amount ($)	Scientific authority
	Canada–Manitoba Forest Renewal Agreement		
Carrigan, D. 10045 - 83 Avenue Edmonton, Alberta T6E 3C5	Computer programming to complete Dispatch Advisor	615	B.S. Lee
Deer Mountain Logging Ltd. 8 Hollinger Drive Swan Hills, Alberta T0G 2C0	Provide field trials of Silva Waddell Scarifier	52,300[c]	J.R. Gorman
Huybers, J. 192 Poplarwood Avenue Winnipeg, Manitoba R2M 1L2	Soil survey	4,860	I.G.W. Corns
Kosowan, S. 303C, 13135 - 127 Street Edmonton, Alberta T5L 1B3	Programming services for a micro-based system	2,860	B.S. Lee
Lee, D. 201, 10235 - 121 Street Edmonton, Alberta T5N 2K6	Provide graphic arts services	4,816[c]	J.K. Samoil

Pedocan Land Evaluation Ltd. 4211 - 95 Street Edmonton, Alberta T6E 5R6	Forest site classification pilot project	41,993	I.G.W. Corns
Pedo-Ecological Consultants Ltd. 10845 - 32A Avenue Edmonton, Alberta T6S 3B8	Revise and condense report on forest management site classification system	400	I.G.W. Corns

ENergy from the FORest (ENFOR)

Life Sciences Programming 602, 5775 Toronto Road Vancouver, B.C. V6T 1X4	Prepare and conduct a series of gaming runs of the aspen calibrated Forcyte II model	7,000	M.J. Apps
Ng, D. 301, 10805 - 79 Avenue Edmonton, Alberta T6E 1S6	Provide programming services to test and refine utility programs for Forcyte II	3,000	M.J. Apps
University of B.C. (Prof. J.P. Kimmins) Faculty of Forestry Vancouver, B.C. V6T 1W5	Modeling support for CFS users; refinements to probe multiple run manager	9,500	M.J. Apps

Continued on next page

APPENDIX D continued

Contractor	Title	Amount ($)	Scientific authority
University of B.C. (Dr. R.D. Spratley) Vancouver, B.C. V6T 1W5	Evaluation of the performance of the aspen calibrated Forcyte II model	5,000	M.J. Apps
Western Ecological Services 205, 3347 Oak Street Victoria, B.C. V8X 1R2	Evaluation of potential use of the Forcyte modeling framework in mixedwood stands	38,177	M.J. Apps
Woodard, P.M. 1010 - 88 Street Edmonton, Alberta T5K 1Y3	Compilation of wood-quality data for trees native to Alberta	2,800	J.M. Powell
Total		836,764	

[a] Equals Alberta portion of funds provided by all three federal-provincial forestry agreements.
[b] Equals Saskatchewan portion of funds provided by all three federal-provincial forestry agreements.
[c] Equals Manitoba portion of funds provided by all three federal-provincial forestry agreements.

APPENDIX E

PUBLICATIONS 1987–88

(As of March 31, 1988)

Alexander, M.E.; De Groot, W.J. 1988. Fire behavior in jack pine stands as related to the Canadian Forest Fire Weather Index (FWI) System. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Poster with text.

Alexander, M.E.; Lanoville, R.A. 1987. Wildfires as a source of fire behavior data: a case study from Northwest Territories, Canada. Pages 86-93 *in* Preprint vol. Ninth Conf. Fire For. Meteorol., April 21-24, 1987, San Diego, California. Am. Meteorol. Soc., Boston, Mass.

Allen, E.A.; Blenis, P.V.; Hiratsuka, Y. 1988. Axenic culture of *Endocronartium harknessii*. Mycologia 80(1):120-123.

Apps, M.J.; Duke, M.J.M.; Turner, B.V. 1987. Fission track mapping of uranium in black spruce (*Picea mariana*) twigs. J. Radioanal. Nucl. Chem. 110(1):245-252.

Ascher, A., editor. 1987. Timberlines. No. 2, Spring 1987. No. 3, Summer 1987. No. 4, Autumn 1987. No. 5, Winter 1987-88. Can. For. Serv., North. For. Cent., Edmonton, Alberta.

Baker, J. 1987. Distribution of N in a simulated profile of a Podsolic Gray Luvisol following urea fertilization. Can. J. Soil Sci. 67:271-280.

Bella, I.E.; Navratil, S. 1987. Growth losses from winter drying (red belt damage) in lodgepole pine stands on the east slopes of the Rockies in Alberta. Can. J. For. Res. 17(10):1289-1292.

Bernier, P.Y. 1987a. Microwave remote sensing of snowpack properties: potential and limitations. Nord. Hydrol. 18:1-20.

Bernier, P.Y. 1987b. Regeneration and growth of lodgepole pine in small openings in the Alberta foothills. Can. J. For. Res. 17:758-759.

Bernier, P.Y. 1987c. Snow evaporation and the aerodynamic properties of an artificial juvenile lodgepole pine stand. Pages 213-215 *in* Preprint vol. 18th Conf. Agric. For. Meteorol. and 8th Conf. Biometeorol. Aerobiol., September 14-18, 1987. Am. Meteorol. Soc., Boston, Mass.

Blenis, P.V.; Hiratsuka, Y.; Mallett, K.I. 1987. Armillaria root rot in Alberta. Univ. Alberta Agric. For. Bull. 10(1):4-5.

Brace, L.G. 1987. Forest vegetation management research and development. Pages 82-92 *in* Industrial vegetation management: in pursuit of excellence. Proc. Semin., March 18, 1987. Chris Campbell Consulting Services, Calgary, Alberta.

Chakravarty, P.; Sidhu, S.S. 1987. Effect of glyphosate, hexazinone, and triclopyr on in vitro growth of five species of ectomycorrhizal fungi. Eur. J. For. Pathol. 17:204-210.

Chakravarty, P.; Sidhu, S.S. 1987. Effect of hexazinone (Pronone™ 5G) on the seedling growth and mycorrhizal incidence of *Pinus contorta* var. *latifolia* and *Picea glauca*. Eur. J. For. Pathol. 17:282-291.

Chrosciewicz, Z. 1988. Forest regeneration on burned, planted, and seeded clearcuts in central Saskatchewan. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-293.

De Franceschi, J.P.; Boylen, D.M. 1987. Costs and benefits of precommercial thinning: an overview and case study. Pages 252-268 *in* Proc. Int. Union. For. Res. Organ. Int. Interdiv. Conf. Thinning, Moscow and Riga, September 9-17, 1985. Part II. Int. Union. For. Res. Organ., Vienna, Austria.

Dymock, I.J.; Dendwick, F.M. 1987. Monitoring viability of overwintering container stock. Pages 21-35 *in* E.M. Harvey, compiler. Proc. 1986 Prairie Fed.-Prov. Nurserymen's Meet., September 9-11, 1986, The Pas, Manitoba. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-287.

Edwards, I.E. 1987. Nutrient regimes and cold hardiness in conifer seedlings. Pages 14-17 *in* E.M. Harvey, compiler. Proc. 1986 Prairie Fed.-Prov. Nurserymen's Meet., September 9-11, 1986, The Pas, Manitoba. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-287.

Feng, J.C. 1987. Persistence, mobility and degradation of hexazinone in forest silt loam soils. Environ. Sci. Health B22(2): 221-233.

Grewal, H., editor. 1987a. Bibliography of lodgepole pine literature. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-291.

Grewal, H.S. 1987b. Biomass productivity in two-year-old aspen cutovers near Calling Lake and Slave Lake, Alberta. Pages 124-128 *in* Z. Stiasny, editor. Proc. Sixth Can. Bioenergy R & D Semin., February 1987, Richmond, B.C. Elsevier Applied Science Publishers, New York.

Harvey, E.M. 1987a. Methods of stock quality monitoring for the prairie provinces. Pages 1-7 *in* E.M. Harvey, compiler. Proc. 1986 Prairie Fed.-Prov. Nurserymen's Meet., September 9-11, 1986, The Pas, Manitoba. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-287.

Harvey, E.M., compiler. 1987b. Proceedings of the 1986 Prairie Federal-Provincial Nurserymen's Meeting. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf.Rep. NOR-X-287.

Harvey, E.M. 1987c. Report on the National Tree Nursery Weed Control Association Workshop. Page 42 *in* E.M. Harvey, compiler. Proc. 1986 Prairie Fed.-Prov. Nurserymen's Meet., September 9-11, 1986, The Pas, Manitoba. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-287.

Hillman, G.R. 1987. Improving wetlands for forestry in Canada. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-288.

Hillman, G.R.; Verschuren, J.P. 1988. Simulation of the effects of forest cover, and its removal, on subsurface water. Water Resour. Res. 24(2):305-314.

Hiratsuka, Y.; Blenis, P.; Chang, K. 1987. The role of biotic and climatic factors in the epidemiology of western gall rust. Univ. Alberta Agric. For. Bull. 10(1): 11-13.

Ives, W.G.H.; Wong, H.R. 1988. Tree and shrub insects of the prairie provinces. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-292.

Josza, L.A.; Powell, J.M. 1987. Some climatic aspects of biomass productivity of white spruce stem wood. Can. J. For. Res. 17(9):1075-1079.

Kennedy, K.A.; Addison, P.A. 1987. Some considerations for the use of visual estimates of plant cover in biomonitoring. J. Ecol. 75:151-157.

Khan, A.A.; Malhotra, S.S. 1987. Effects of vanadium, nickel and sulphur dioxide on polar lipid biosynthesis in jack pine. Phytochemistry 26(6):1627-1630.

Kurz, W.A.; Apps, M.J.; Chan, Y.H. 1987. PROBE: a program to facilitate user-friendly gaming with FORCYTE. Pages 160-164 *in* Z. Stiasny, editor. Proc. Sixth Can. Bioenergy R & D Semin., February 1987, Richmond, B.C. Elsevier Applied Science Publishers, New York.

Lee, B.S.; Pickford, S.G. 1987. An expert system for use in dispatching suppression resources to wildfires. Pages 245-248 *in* Preprint vol. Ninth Conf. Fire For. Meteorol., April 21-24, 1987, San Diego, California. Am. Meteorol. Soc., Boston, Mass.

Lewis, V.R.; Volney, W.J.A.; Milstead, J.E. 1987. Modelling the distribution of leaves, oakworms and damaged foliage for the coast live oak. Pages 127-131 *in* Proc. Symp. Multiple-use Manage. Calif. Hardwood Resour., November 12-14, 1986, San Luis Obispo, California. U.S. Dep. Agric., For. Serv., Pac. Southwest For. Range Exp. Stn., Berkeley, California. Gen. Tech. Rep. PSW-100.

Maynard, D.G.; Kalra, Y.P.; Radford, F.G. 1987. Extraction and determination of sulfur in organic horizons of forest soils. Soil Sci. Soc. Am. J. 51(3):801-805.

McAlpine, R.S. 1987a. LAPFWI and LAPFBP: two 'BASIC' computer programs to assess fire danger and potential fire behavior. Pages 243-244 *in* Preprint vol. Ninth Conf. Fire For. Meteorol., April 21-24, 1987, San Diego, California. Am. Meteorol. Soc., Boston, Mass.

McAlpine, R.S. 1987b. Two BASIC programs for fire danger and fire behavior computations. Can. For. Serv., North. For. Cent., Edmonton, Alberta. For. Manage. Note 43.

Milstead, J.E.; Volney, W.J.A.; Lewis, V.R. 1987. Environmental factors influencing California oakworm feeding on California live oak. Pages 132-138 *in* Proc. Symp. Multiple-use Manage. Calif. Hardwood Resour., November 12-14, 1986, San Luis Obispo, California. U.S. Dep. Agric., For. Serv., Pac. Southwest For. Range. Exp. Stn., Berkeley, California. Gen. Tech. Rep. PSW-100.

Northern Forestry Centre. 1987. Program Review 1986-87. Can. For. Serv., North. For. Cent., Edmonton, Alberta.

Pickford, S.G. 1987. Using the "WNDCOM" wind prediction model in a fire dispatching system. Pages 222-226 *in* Preprint vol. Ninth Conf. Fire For. Meteorol., April 21-24, 1987, San Diego, California. Am. Meteorol. Soc., Boston, Mass.

Radvanyi, A. 1987. Snowshoe hares and forest plantations: a literature review and problem analysis. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-290.

Samoil, J.K., Boughton, B., editors. 1987. Saskatchewan's forests. Can. For. Serv., North. For. Cent., Edmonton, Alberta. For. Rep. 33.

Schunke, E.; Zoltai, S.C. 1988. Earth hummocks (thufur). Pages 231-245 *in* M.J. Clark, editor. Advances in periglacial morphology. John Wiley & Sons, Chichester, England.

Singh, T. 1987a. Generalizing biomass equations for the boreal forest region of west-central Canada. For. Ecol. Manage. 17:97-107.

Singh, T. 1987b. Heat of combustion and energy potential of tree species in western Canada. Natl. Woodlands 10(4):8-9.

Singh, T. 1987c. Prediction error in tree biomass regression functions for western Canada. Pages 199-208 *in* Estimating tree biomass regressions and their error. Proc. Workshop Tree Biomass Regression Funct. Contrib. Error For. Inventory Estimates, May 26-30, 1986, Syracuse, New York. U.S. Dep. Agric., For. Serv., Northeast. For. Exp. Stn., Broomall, Pennsylvania. Gen. Tech. Rep. NE-117.

Singh, T. 1987d. Wood density variations in thirteen Canadian tree species. Wood Fiber Sci. 19(4):362-369.

Singh, T. 1988a. Current applied climatological research in Alberta. Proceedings of the Workshop and 11th Annual Meeting of the Alberta Climatological Association, February 24, 1987. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-294.

Singh, T. 1988b. Estimating downed-dead roundwood fuel volumes in central Alberta. Can. For. Serv., North. For. Cent., Edmonton, Alberta. Inf. Rep. NOR-X-289.

Singh, T.; Kostecky, M.M. 1987a. Calorific value variations in components of 10 Canadian tree species. Can. J. For. Res. 16(6):1378-1381.

Singh, T.; Kostecky, M.M. 1987b. Energy potential from Manitoba forest biomass. Pages 101-105 *in* Z. Stiasny, editor. Proc. Sixth Bioenergy R & D Semin., February 1987, Richmond, B.C. Elsevier Applied Science Publishers, New York.

Swanson, R.H. 1987. Applying hydrologic principles to the management of subalpine forests for water supply. Pages 79-85 *in* Management of subalpine forests: building on 50 years of research. Proc. Tech. Conf., Silver Creek, Colorado, July 6-9, 1987. U.S. Dep. Agric., For. Serv., Rocky Mtn. For. Range Exp. Stn., Fort Collins, Colorado. Gen. Tech. Rep. RM-149.

Walker, N.R.; Ball, W.J. 1987. Container seedling field performance after 10 years. Can. For. Serv., North. For. Cent., Edmonton, Alberta. For. Manage. Note. 44.

Wu, J.; Wong, H.R. 1987. Colonization of lodgepole pine stumps by ants (Hymenoptera: Formicidae). Can. Entomol. 4:397-398.

Zoltai, S.C. 1987. Peatlands and marshes in the wetland regions of Canada. Pages 5-13 *in* D.M. Rosenberg and H.V. Danks, editors. Aquatic insects of peatlands and marshes in Canada. Mem. Entomol. Soc. Can. 140.

FEDERAL-PROVINCIAL FORESTRY DEVELOPMENT AGREEMENT REPORTS 1987–88

(As of March 31, 1988)

ALBERTA

Alberta Forest Service, Reforestation and Reclamation Branch, Genetics Section. 1987. Trees improvement applied research and technology transfer. Interim progress report.

Alberta Research Council, Industrial Technologies Department. 1987a. Aspen vs. black poplar differences. Phase I—waferboard/OSB.

Alberta Research Council, Industrial Technologies Department. 1987b. Coatings and embossed panels.

Alberta Research Council, Industrial Technologies Department. 1987c. Dimensional stabilization state of the art review.

Alberta Research Council, Industrial Technologies Department. 1987d. Isocyanates (M.D.I.).

Alberta Research Council, Industrial Technologies Department. 1987e. Machine stress rating panel products.

Alberta Research Council, Industrial Technologies Department. 1987f. Oriented strandboard (OSB) optimization.

Alberta Research Council, Industrial Technologies Department. 1987g. Stressed skin panels.

Amirault, P.A.; Gates, H.; Niederleitner, S. 1987. Spruce budworm in the Footner Lake forest—1987: a status report.

Bamsey, C.R. 1987. Directory of primary wood-using industries in Alberta—1986.

Byers, G. (Pelican Spruce Mills Ltd.). 1988. On-line system for board product quality control.

Canpolar Inc. 1987. Preliminary assessment of impulse radar to detect decay in hardwood.

Dempster, W.R., Stevens, N.A. (W.R. Dempster and Associates Ltd.). 1987. Risk management in forest planning.

Foal Enterprises Inc. 1987. Aspen shingles and shakes in Alberta.

Gellner, B., compiler. 1988. Pacific Rim markets for forest products in the 1990s: economic assessment of demand and supply. Proceedings of the Resource Information Systems, Inc., Annual Conference, Vancouver, B.C., October 20-22, 1987.

Gibbard, D.A.; Sutherland, B.J. 1987. 1986 site preparation equipment trials in Alberta: Donaren 180D powered disk trencher and Sinkkila HMF scarifier.

Hailey, J.R., Morris, P.I. (Forintek Canada Corp.). 1987. Application of scanning and imaging techniques to assess decay and wood quality in logs and standing trees.

Hallmark Engineering Ltd.; Woodbridge, Reed and Associates Ltd. 1988. A study of Alberta's secondary forest products manufacturing industry.

Hillman, G.R. 1988. Improving wetlands for forestry in Alberta.

Ligna Technologies Ltd. 1987. Report on cement bonded particleboard, its applications and a preliminary assessment of a plant to be located in Alberta.

Micko, M.M. 1987. Alberta aspen vs. black poplar wood quality differences.

Navratil, S.; Lane, J. 1987. Control of aspen development in areas designated for softwood production: summary of satellite trials A, B and C.

Northern Forestry Centre. 1987. Aspen quality workshop. Proceedings of a workshop held February 12, 1987, Edmonton, Alberta.

Steiner, P.R.; Calvé, L.; Clarke, M.R.; Shields, J.A. (Forintek Canada Corp.). 1987. Potential for enzymatic lignin-based adhesives state of the art review.

Steele, T.; Williamson, T., compilers. 1987. The continuing challenge: competition and new products in the world forest products markets. Proceedings of the Resource Information Systems, Inc., Annual Conference, Boston, Massachusetts, September 23-26, 1986.

Thomas, P.R. (Enotech Services Limited). 1987. Preparation of pulps from sound Alberta aspen and balsam poplar by various processes.

Wengert, E.M. (Virginia Polytechnic Institute and State University). 1988. Utilization and marketing opportunities for Alberta aspen solid wood products.

Wong, A. (Arbokem Inc.). 1987. Review of pulping and papermaking properties of aspen.

Wong, A.; Szabo, T., editors. Proceedings of the workshop on aspen pulp, paper and chemicals, March 25-26, 1987, Edmonton, Alberta.

SASKATCHEWAN

Barth, G.R. 1988. White spruce stock performance trial in the mixedwood section of Saskatchewan.

Day, R.J.; Frazer, N.J. 1987. Forest tree nursery cultural regimes at Prince Albert and Big River nurseries.

International Forestsearch (Canada) Ltd. 1988. Saskatchewan Christmas Tree Growers' Association stock acquisition study.

Kabzems, A.; Kosowan, A.L.; Harris, W.C. 1986. Mixedwood section in an ecological perspective: Saskatchewan. Can. For. Serv. and Saskatchewan Parks Renewable Resour., For. Div., Prince Albert, Saskatchewan. Tech. Bull. 8. Second ed.

Norplan Consulting; Bell and Associates. 1986. A study of the economics of utilizing Saskatchewan hardwoods.

Prairie Environmental Services Inc. 1987. Recommendation for the development of a forest vegetation management plan for Greenwater Lake Provincial Park.

Saskatchewan Council of Independent Forest Industries. 1987. Comparison of independent industry features within forest legislation for selected provinces.

Sidders, D.; Adamson, M. [1987]. 1986/87 powered disc trencher equipment trial.

Woodland Resource Services. 1987. A review of white spruce and jack pine seed collection, processing and utilization procedures used in Saskatchewan.

MANITOBA

Chrosciewicz, Z. 1988. Burning for black spruce regeneration on a lowland cutover site in southeastern Manitoba. Forest Management Demonstration Note 9.

De Franceschi, J.P. 1988. Labor and machine productivity for pre-commercial thinning, manual tree planting and mechanical site preparation in Manitoba: 1987 data.

De Franceschi, J.P.; Steele, T. 1987a. Labor productivity for manual tree planting in Manitoba.

De Franceschi, J.P.; Steele, T. 1987b. Machine productivity for disc trenchers, drum choppers, and Bracke scarifiers in Manitoba.

Walker, N.R. 1987a. Barrel and chain scarification promotes successful jack pine regeneration in southeastern Manitoba. Forest Management Demonstration Note 6.

Walker, N.R. 1987b. Elk and moose browsing prevents the growth of a new trembling aspen/balsam poplar forest. Forest Management Demonstration Note 2.

Walker, N.R. 1987c. Naturally regenerated jack pine has improved stem form. Forest Management Demonstration Note 5.

Walker, N.R. 1987d. Post-burn interval does not enhance direct seeding or planting survival of jack pine. Forest Management Demonstration Note 4.

Walker, N.R. 1987e. Regular spacing increases merchantable volume in white spruce. Forest Management Demonstration Note 7.

Walker, N.R. 1988a. Experimental seeding in 1920 produces overstocked stands of white spruce; jack pine destroyed by hares. Forest Management Demonstration Note 8.

Walker, N.R. 1988b. Scarification in 1966 produces densely stocked areas of natural white spruce. Forest Management Demonstration Note 10.

Walker, N.R.; Witt, D.R. 1987a. White spruce sawlogs produced 68 years after planting. Forest Management Demonstration Note 3.

Walker, N.R.; Witt, D.R. 1987b. White spruce transplant stock grading increases yield, 59 years after planting. Forest Management Demonstration Note 1.